DIXIE DRIVE
Interchange
STRUCTURE TYPE SELECTION REPORT

UDOT PROJECT S-I15-1(77)6
PIN 5729

JANUARY 13, 2009

HORROCKS
ENGINEERS

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HORROCKS ENGINEERS

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February 24, 2009

Fred Doehring, P.E.
Deputy Bridge Engineer, Design
Utah Department of Transportation
4501 South 2700 West
Salt Lake City, Utah 84119

RE: Structure Type Selection Report
Dixie Drive Interchange Environmental Assessment
Project No. S-I15-1(77)6
Washington County

Dear Mr. Doehring:

This report summarizes our type selection study for the proposed structures carrying Dixie Drive over I-15 and the South Convention Center Drive as well as I-15(northbound, southbound and on/off ramps) over the Santa Clara River in St. George. These bridges are all located near Milepost 5.

Attached for your review and approval are structure type selections. Conceptual situation and layout sheets for each structure are included. Unit costs are based on recent projects in the area and have not been adjusted for inflation. Construction and engineering contingencies have been included as well.

Please let us know if there are questions or comments regarding this submittal. I can be contacted at (801) 763-5100.

Sincerely,
HORROCKS ENGINEERS

Michael A. Dobry, S.E.
Senior Structures Engineer

cc: File
Kim Manwill, UDOT Project Manager, Region 4

From: "Robert Nash" <rnash@utah.gov>
To: "Mike Dobry" <MikeD@horrocks.com>
CC: "Jason Richins" <JTRICHINS@utah.gov>
Date: 1/5/2009 10:31 AM
Subject: Re: Dixie Drive EA Comment Responses

Mike,

Sorry for the delay I have been off. You have adequately addressed my comments. Go ahead.

Thanks,
Bob

>>> "Mike Dobry" <MikeD@horrocks.com> 12/30/2008 12:24 PM >>>
Attached are our responses to your comments. If you agree with our disposition we'll make the changes in the report.

Thanks,

Mike Dobry
Horrocks Engineers
Work: 801-763-5138
Fax: 801-756-2362
Cell: 801-369-4756
miked@horrocks.com

UDOT STRUCTURES DIVISION COMMENT AND RESOLUTION SHEET				CODES: A. ACCEPT COMMENT—WILL BE CORRECTED, ADDED, OR CLARIFIED. B. DESIGNER WILL EVALUATE. C. DELETE COMMENT D. DEPARTMENT TO EVALUATE.	
DOCUMENT CONTROL NUMBER:		REVIEW TYPE: SIZE AND TYPE REPORT		REVIEWER(S): ROBERT NASH	DATE: 12/10/08
DESCRIPTION: DIXIE DRIVE INTERCHANGE STRUCTURE TYPE SELECTION REPORT		DESIGNER: HORROCKS ENGINEERS		DISCIPLINE: STRUCTURES	CRM:
ITEM NO.	DWG. NO.(1)	COMMENTS	CODE(2)	RESPONSE(2)	FINAL DISPOSITION(3)
1	Page 2	Structure Number C-374 is a steel bridge over the Virgin River. I think it should be F-314. Please verify this and other information related to this bridge.	A	The structure number was incorrect but the description was OK. Will correct.	A
2	Page 35	I believe spread footings would need to be below the scour depth for up to a 500 year flood. This would require cofferdams and dewatering to construct. Also based on recent history with this river and flooding I would advise against the use of spread footings. Consult the Departments Current Drainage Manual for guidance and policies. Chapter 10 of the Departments Current Drainage Manual [Section 10.5.1] & [Section 10.6.7] identifies general hydraulic criteria and refers to FHWA Technical Advisory 5140.23, and HEC 18, HEC 20 and HEC 23 as documents for bridge scour design and analysis and it is these publications that we use when we evaluate structures for vulnerability to scour. Chapter 10 can be accessed over the web at the following web address http://www.dot.state.ut.us/download.php/tid=826/Chapter%2010.pdf	A	Drilled Shafts are anticipated and we agree caps should be avoided where possible. The text was accidentally carried over from a previous section. Will correct.	A

(1) Indicate drawing no./page no. or use "G" for general comment.
(2) To be filled out by Designer.
(3) To be determined in subsequent comment resolution meeting/discussion (list date).

Note: The intended use of this form is to provide a means for the Department to comment on submitted structural design plans and calculations. All comments must be satisfactorily resolved and incorporated into the contract documents before the design can be approved.

UDOT STRUCTURES DIVISION
COMMENT AND RESOLUTION SHEET

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A. ACCEPT COMMENT—WILL BE CORRECTED, ADDED, OR CLARIFIED.
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ITEM NO.	DWG. NO.(1)	COMMENTS	CODE(2)	RESPONSE(2)	FINAL DISPOSITION(3)
3	Page 36	Please verify that weathering steel is appropriate for this location. If weathering steel is used some kind of protective overlay would need to be used on the deck.	A	After discussing this note we agree that weathering steel could be a problem due to the humidity above the water. The relatively small vertical clearance under the bridge could increase the problem. We will reword the report to not specify that 'weathering' steel be used. Painting the girders can alleviate the problems. The decision on steel type should be made during final design.	A
4	I-15 over Santa Clara River Alt.1A Sht 2 of 2	Please verify 2 feet 9 inches of structure depth is adequate.	A	In order to get such a limited structure depth to work we had to add girder lines and have tighter girder spacing. The load rating is 1.02 and the deflections meet the L/800 rule.	A
5	Page 64	Empirical deck design cannot be used if precast panels are used. Therefore I recommend you add a note to that effect.	A	Will add note.	A

(1) Indicate drawing no./page no. or use "G" for general comment.
(2) To be filled out by Designer.
(3) To be determined in subsequent comment resolution meeting/discussion (list date).

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TABLE OF CONTENTS

STRUCTURE TYPE SELECTION REPORT

GENERAL

The project location is near Milepost 5.6 on Interstate 15. The proposed extension of Dixie Drive will meet up with an overpass Single Point Interchange (SPI) that spans I-15 and then cross over Convention Center Drive. I-15 will be widened for new on and off ramps and realigned for future lanes in the median. Twin replacement bridges and new ramp bridges will carry I-15 mainline and ramps over the Santa Clara River. See Figure 1 for project location and existing conditions, Figure 2 for structure locations, and Figure 3 (replicated from Figure 2-21 in the Environmental Assessment) for the project's preferred alternative.

This report is being submitted during the preliminary design phase to determine structure selection in conjunction with a FEMA Conditional Letter Of Map Revision (CLOMR). The I-15 mainline bridges have a limited structure depth available due to two main issues: The closeness of the SPI and required vertical clearance and the FEMA 100-yr water surface elevation. There are also significant right-of-way restrictions south of the river crossing.

The project is primarily cost driven with moderate user impacts. With the exception of I-15 reconstruction, the majority of the construction work will be new roads and structures. The I-15 traffic delays should be minimal.

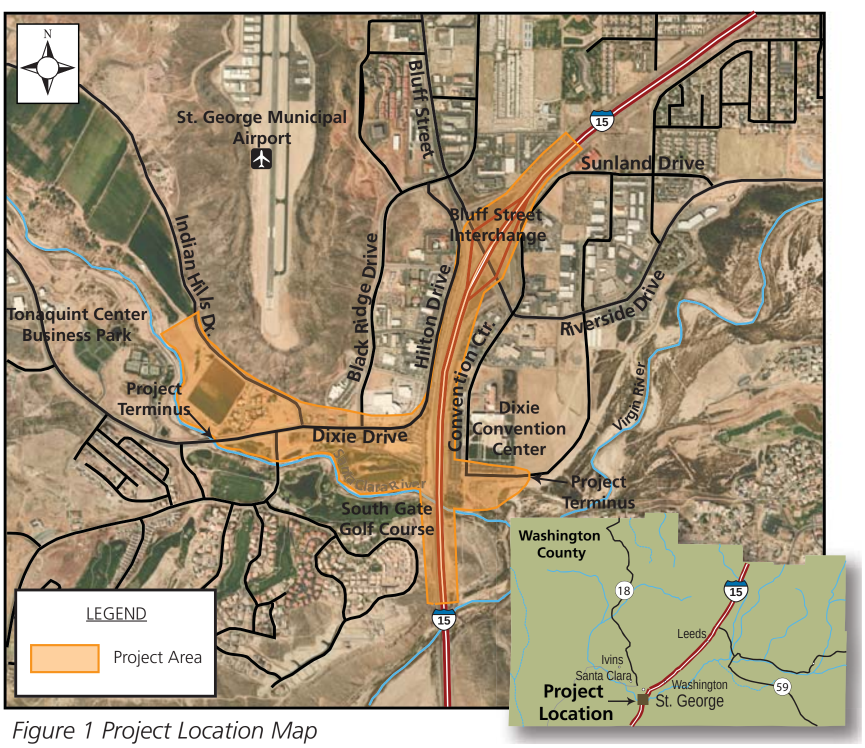

Figure 1 Project Location Map

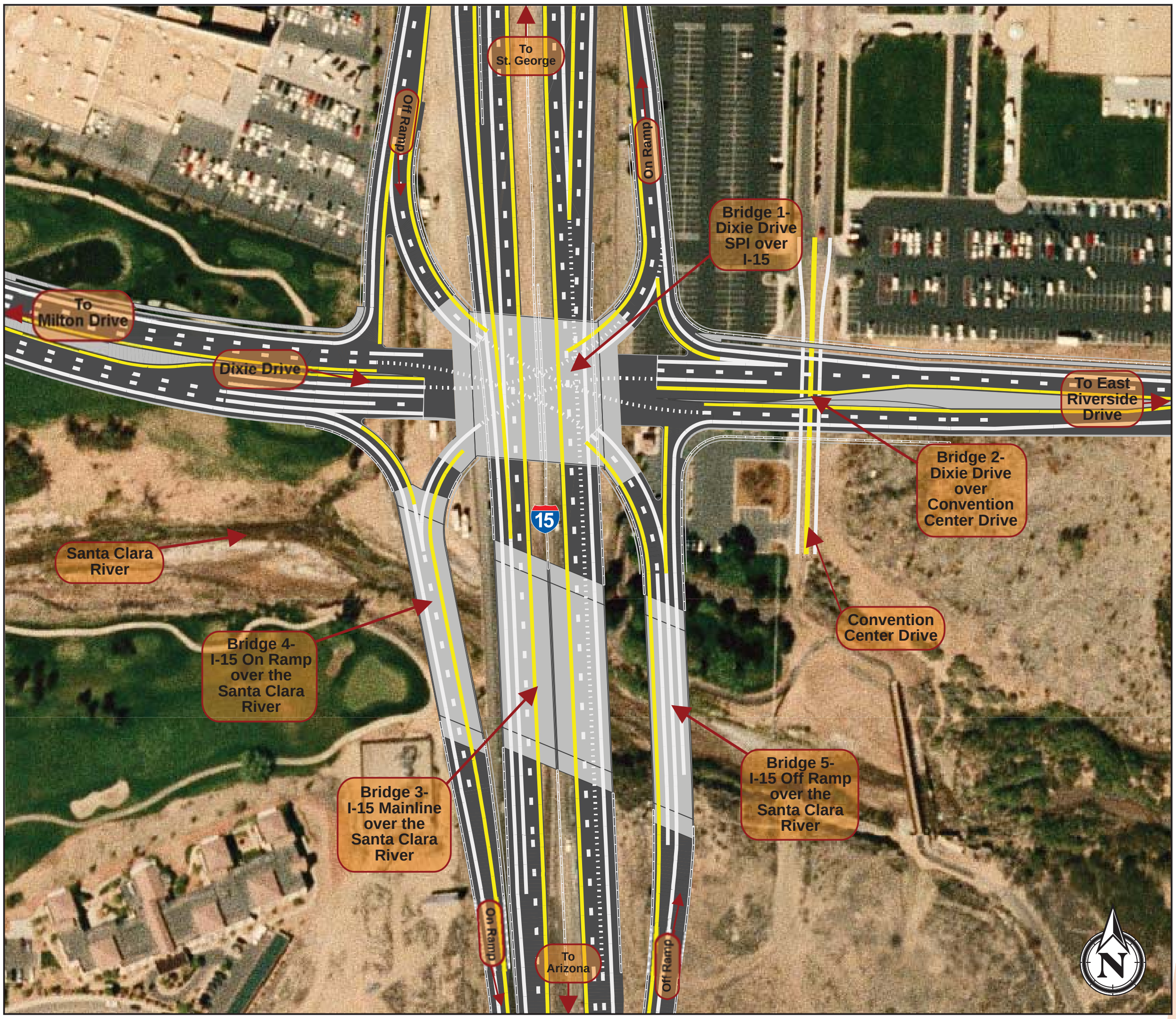

Figure 2 Structure Location Map

EXISTING CONDITIONS

Site Description

The existing ground at the Dixie Drive SPI is within I-15 right-of-way. Convention Center Drive is an access road for parking and a pedestrian trail that runs along the Santa Clara River bank. The river crossing is typical ground adjacent to the Santa Clara River. See the Environmental Assessment document for more detailed descriptions of the existing site.

Existing Structures

The existing southbound I-15 bridge is a three span PreCast/PreStressed (PC/PS) AASHTO Type III and Type IV concrete girder bridge with vertical wall abutments. The structure number is F-314 and the Structure Inventory and Appraisal (SIA) has a rating of 93.1. The inspection report notes debris build up and local pier scour. Scour effects have exposed the footings and have required remediation. The deck has an overlay.

The northbound I-15 bridge is a three span Cast-In-Place (CIP) concrete frame bridge with vertical wall abutments. The structure number is D-673 and the SIA has a rating of 83. The inspection report notes vegetation that is choking the channel. Flooding has shifted the channel to scour the north abutment and pedestrian trail. The trail was repaired and sheet piles were used for protection.

A CIP wall between and around the abutments retains the bridge embankments.

Existing Utilities

There is a *[size]* sewer line underneath the trail to be protected in place.

PROPOSED CONDITIONS

Site Description

The Dixie Drive overpass SPI will be constructed on new embankment with wrap around MSE retaining walls. The I-15 vertical profile will not be changed. Convention Center Drive will be realigned under Dixie Drive.

A hydraulic analysis has been performed to ascertain water surface elevations during significant flood events. All structures must meet the 2' minimum freeboard for the 100-yr event based on the FEMA mapping. The proposed structures will utilize spill-through abutments instead of the existing vertical wall abutments to mitigate constriction of the channel.

The pedestrian trail will be realigned to meet the new vertical and horizontal conditions. St. George City has also requested the trail to have an 'open' feel.

Roadway Design

The roadway design is preliminary and subject to change during final design.

Management of Traffic (MOT)

Construction phasing and MOT will be solidified during final design. A temporary bridge widening is anticipated on the southbound I-15 bridge to accommodate 2 lanes of traffic each way during construction. The cost for a temporary structure would be approximately $1.3 million. Partial construction of the proposed structure could function as the widening if the vertical profile remains unchanged. See Figure 3 for the location.

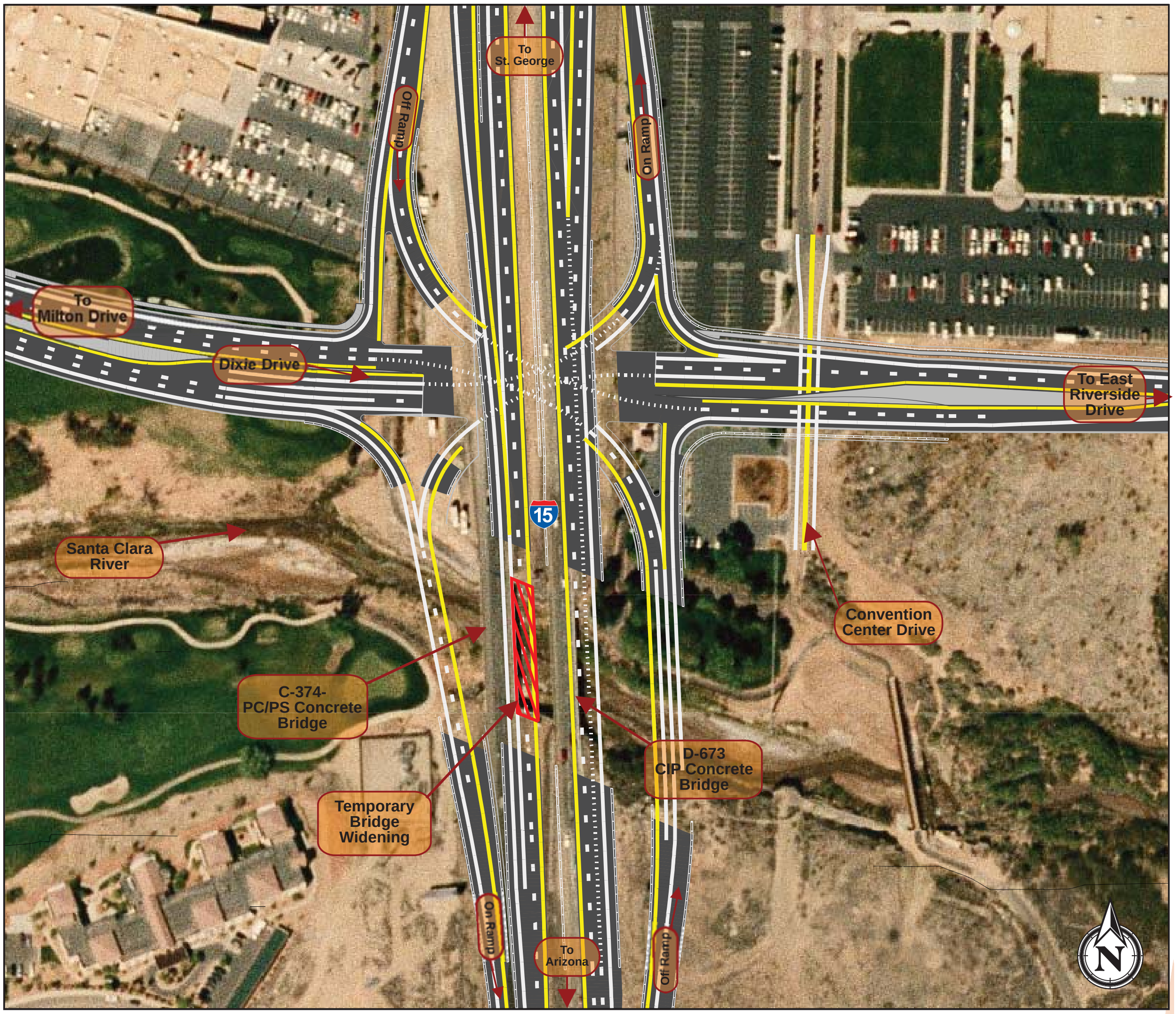

Figure 3 Temporary Widening Location

Proposed Structures over the Santa Clara

Replacement of the existing I-15 mainline structures is required due to the future widening and horizontal roadway realignment. There is an electric power distribution substation southwest of the river crossing. The alignment had to be shifted to minimize roadway construction and right-of-way costs. The existing northbound bridge is not structurally sufficient to widen and needed to be replaced. The decision was made with UDOT to replace both bridges.

BRIDGE PARAPET

A standard 3'-6" Utah Department of Transportation (UDOT) parapet, designed to meet AASHTO TL-4 impact requirements, is utilized at each edge of deck.

Future Utilities

Conduits will be provided in each parapet for ATMS and any future use. The actual number and size will be determined during final design.

Deck Protection

UDOT has requested that a deck sealer be considered. There are several states that currently use deck sealers on new construction, but opinion on its cost-effectiveness is varied. States that use epoxy coated rebar typically do not use a sealer on new construction, but will use it to repair cracks and perform periodic maintenance. Because all rebar for UDOT structures is epoxy coated, a sealer should not be required. However, we have included the cost of the sealer in the total cost estimate should UDOT decide to utilize it.

Aesthetic Treatments

Aesthetic treatments are not defined for this project. A cost contingency has been provided. Typical treatments are concrete formliners, paint, and stain.

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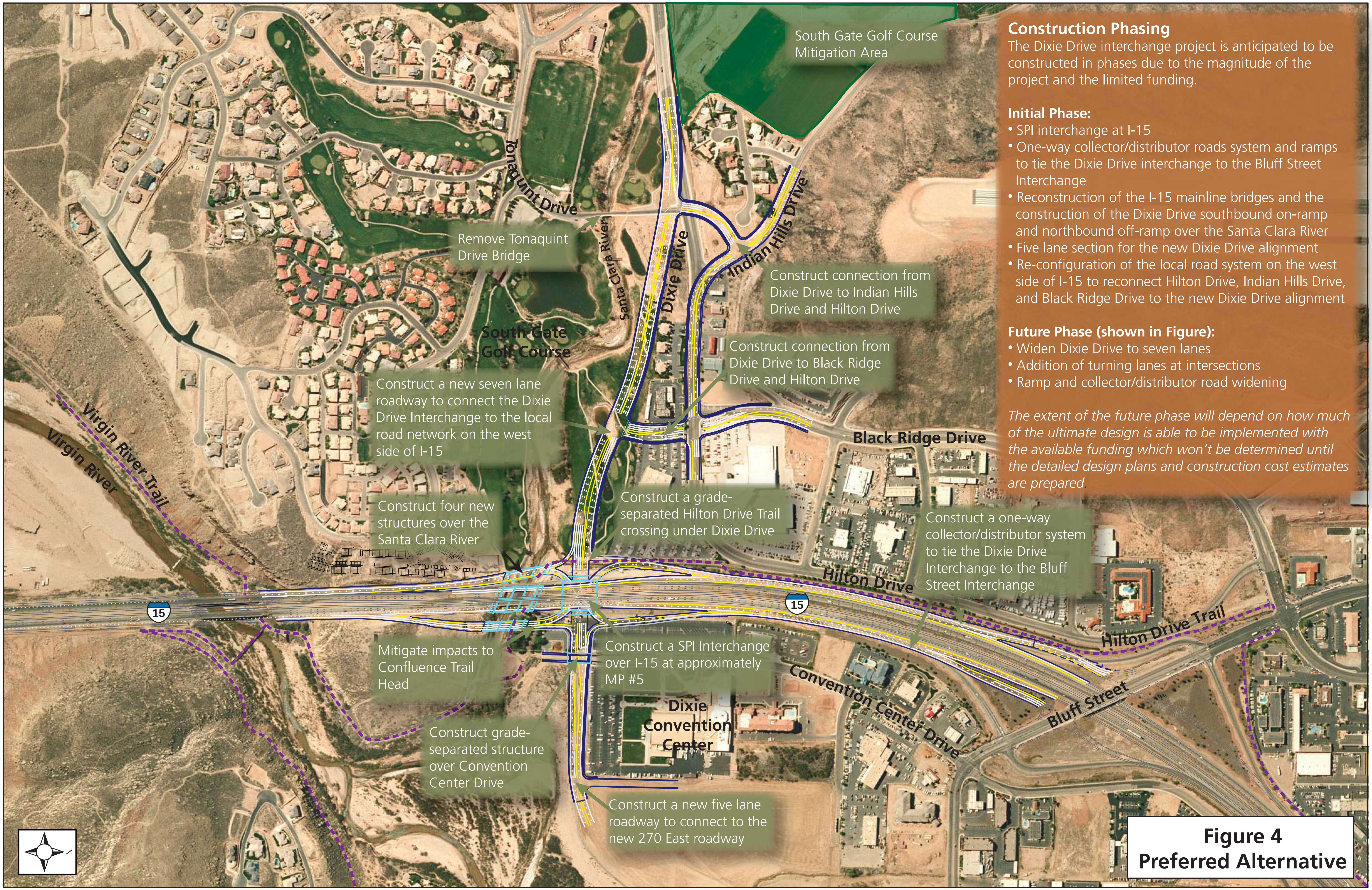


Figure 4
Preferred Alternative

BRIDGE 1: DIXIE DRIVE SPI OVER I-15 PROPOSED STRUCTURE

DESCRIPTION

This structure is a two span girder-slab bridge. The deck accommodates a signalized intersection for eastbound and westbound traffic along with two on ramps and two off ramps. The out-to-out bridge width is 197'-6" with spans of 91'-6" and 81'-6". The spans are unbalanced because of a merging southbound ramp. These spans also allow for a future travel lane in the I-15 median. Dixie Drive is on a horizontal and vertical tangent at the structure. There is a standard -2% cross slope away from the centerline of Dixie Drive. The edge of deck and girders are not parallel to Dixie Drive to reduce cost.

The edge of deck does not follow the curve of the ramp alignments. It is squared off with the edges of the abutments. Cost savings from reduced deck volumes are greatly outweighed by an expensive curved steel girder grid system.

An overhead sign structure will be located directly over the middle bent. The sign structure supports pass directly through the deck and into the integral diaphragm between the girders. The columns are centered between girders outside of the clear zone.

Constructability

A crossover is anticipated to shift I-15 traffic to one side. This allows access to construct the bent with minimal temporary shoring. The contractor can also use the on and off ramps that run parallel to I-15 as an alternate traffic detour. Traditional scheduling and construction techniques can be used in either case.

Potential Accelerated Bridge Construction (ABC) methods for the structure are precast substructures and deck panels. Total construction duration can be decreased by rapid substructure erection before paving operations. Full or partial depth precast deck panels can reduce construction duration but are typically more expensive and have a shorter life span than a traditional deck.

This project is anticipated to use the Construction Management/General Contractor (CMGC) method of contracting so that the contractor will be consulted on preferred construction methods.

Long Term Maintenance/Inspection

Each alternative utilizes closed joints except for expansion joints between the sleeper slabs and approach slabs. Open superstructures are easier to inspect and this bridge type is preferred. The PC/PS concrete girders have lower life cycle costs than steel girders; however, the steel girders are more resilient to vertically-oversized vehicle impacts.

Foundations

A formal geotechnical analysis has not been performed. Existing bridge soil logs were reviewed for preliminary recommendations. Local conditions favor drilled shafts or spread footings. Spread footings under bent columns and drilled shafts under abutments are anticipated. During final design, consideration will be given to multi-column bents on isolated drilled shafts to reduce the excavation footprint.

Superstructure

Three superstructure types were considered and are detailed in the Structure Alternatives section of this report. Alternatives are either prestressed concrete or weathering steel girders with a composite concrete deck.

SUPERSTRUCTURE TYPE ANALYSIS AND COMPARISON

Three structure alternatives were considered. All alternatives use the same foundations (caps on drilled shafts for abutments and spread footings under bent columns) as recommended in the Foundations section. All superstructure alternatives have fixed bearings at the bents and abutments. Expansion joints are estimated between approach slabs and sleeper slabs. MSE retaining walls are required for roadway embankment and not considered in the cost of the structure. A 10% contingency was applied to the bridge cost along with a 10% design engineering and 15% construction engineering cost.

The estimated deck area is 34,661 ft^2. Estimated costs include the cost of girders, deck and haunches, diaphragms, parapets, deck sealants, approach slabs, sleeper slabs, abutments, bents, drilled shafts, backfill borrow, electrical work, and bridge aesthetics.

Single span options utilizing post tension concrete girders or built-up steel girders were not evaluated because of their significantly deeper structure depth and resulting increase in earthwork and MSE walls. Section depth limitations eliminated these options.

Alternative 1A – PC/PS AASHTO Type IV Girders

The superstructure consists of 19 composite AASHTO Type IV girders with cast-in-place concrete decks. Bents use semi-integral diaphragms and abutments have typical integral diaphragms. Wingwalls and MSE walls retain the embankment behind the abutments.

Advantages of this alternative are cost reliability and low maintenance issues. Historically, concrete prices have been more stable than steel. Standard formwork can be used and fabrication time is short. PC/PS girder bridges are traditional UDOT structures and require little maintenance. Corrosion will not be an issue and life cycle costs are minimal.

Disadvantages are higher dead loads and girder camber can vary from what is anticipated. Vehicular impact damage is difficult to fix.

Estimated Probable Construction Cost:	\$5.05M
	\$146/ft^2 of deck
Estimated Design and Construction Engineering Cost:	\$1.26M
Estimated Construction and Excavation Savings:	\$-75,000
Comparative Cost:	\$6.24M

Alternative 1B – PC/PS AASHTO Type V Girders

The superstructure consists of 16 composite AASHTO Type V girders with cast-in-place concrete decks. Bents use semi-integral diaphragms and abutments have typical integral diaphragms. Wingwalls and MSE walls retain the embankment behind the abutments.

Advantages and disadvantages of this superstructure type are similar to Alternative 1A. The increased structure depth from Type V girders will increase the cost of embankment fill and MSE walls required for Dixie Drive and its ramps.

The structure depth for this alternative was set as the baseline and therefore there are no construction and excavation savings.

Estimated Probable Construction Cost:	\$5.09M
	\$147/ft^2 of deck
Estimated Design and Construction Engineering Cost:	\$1.27M
Estimated Construction and Excavation Savings:	\$0
Comparative Cost:	\$6.36M

Alternative 2A – Weathering Steel Plate Girder Bridge

The superstructure consists of 16 composite, parabolically haunched weathering steel plate girders with a cast-in-place concrete deck. Bents use semi-integral diaphragms and abutments have typical integral diaphragms. Wingwalls and MSE walls retain the embankment behind the abutments.

Advantage of this alternative is smaller dead load and resistance to vehicular impact. The structure depth is similar to Alternative 1A.

Disadvantages are more complicated fabrication and increased superstructure erection time. There are also increased life cycle costs associated with steel.

Estimated Probable Construction Cost:	\$5.54M
	\$160/ft^2 of deck
Estimated Design and Construction Engineering Cost:	\$1.38M
Estimated Construction and Excavation Savings:	\$-121,000
Comparative Cost:	\$6.80M

ALTERNATIVE COMPARISON SUMMARY

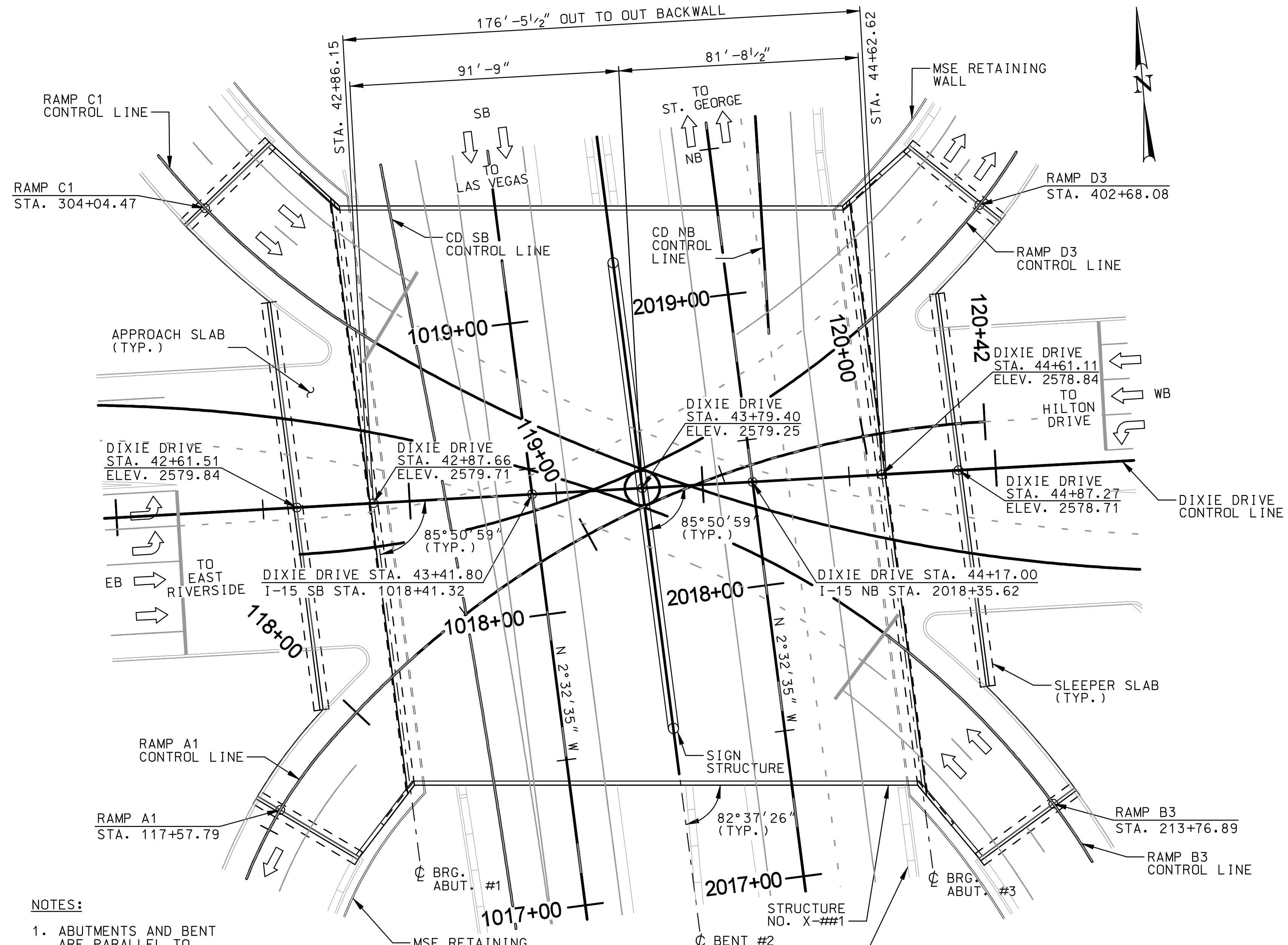
A two span PC/PS AASHTO Type IV concrete girder-slab bridge (Alternative 1A) is the least cost alternative. The alternatives rank, according to cost, as follows:

Rank	Alternative	Alternative Description	Comparative Cost
1	1A	PC/PS AASHTO Type IV Girders	$6.24M
2	1B	PC/PS AASHTO Type V Girders	$6.36M
3	2A	Weathering Steel Plate Girders	$6.80M

Alternative 2A is significantly more costly than other alternatives. Alternative 1B's reduced superstructure costs do not outweigh the increase in embankment and MSE retaining wall costs.

The design life of the new structure is 75 years. The total estimated cost of the least cost alternative is $6.32 million. This equates to a total cost per deck area of $182/ft^2.

See following for preliminary situation and layout sheets and a summary of quantities.

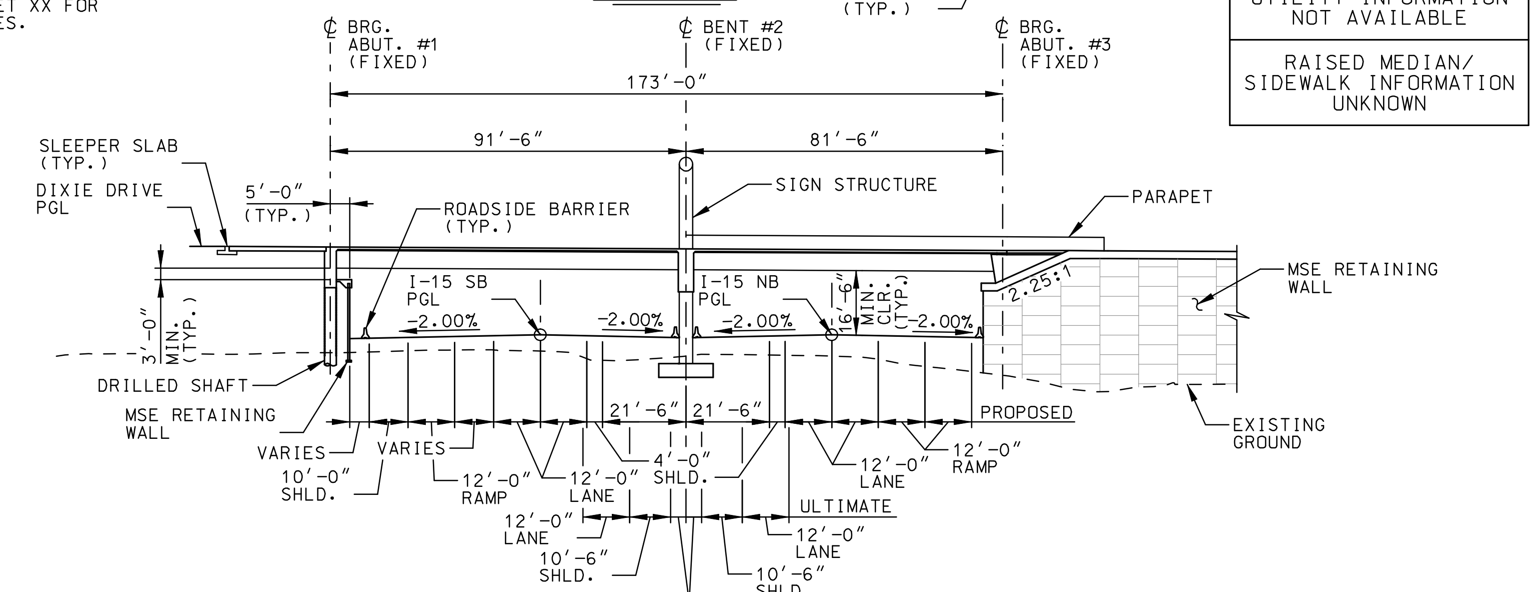


PLAN

NOTES:

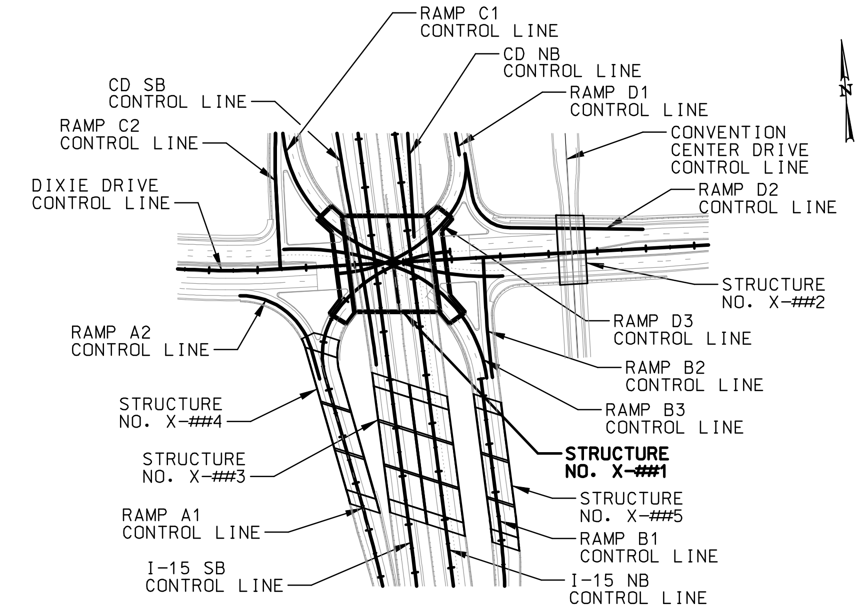
1. ABUTMENTS AND BENT ARE PARALLEL TO N 2°32'35" W.
2. SEE SHEET XX FOR UTILITIES.

UTILITY INFORMATION NOT AVAILABLE
RAISED MEDIAN/ SIDEWALK INFORMATION UNKNOWN



ELEVATION

NORMAL TO I-15



LOCATION PLAN

INDEX OF SHEETS

GENERAL NOTES

1. USE COATED DEFORMED BILLET-STEEL BARS CONFORMING TO AASHTO M 284 OR M 111 AND M 31 GRADE 60 FOR ALL REINFORCING STEEL.
2. USE STRUCTURAL STEEL CONFORMING TO AASHTO M 270 GRADE 36 EXCEPT WHERE NOTED OTHERWISE.
3. CHAMFER ALL EXPOSED CONCRETE CORNERS ¾" EXCEPT WHERE NOTED OTHERWISE.
4. PROVIDE 2" CONCRETE COVER TO REINFORCING STEEL EXCEPT WHERE NOTED OTHERWISE.
5. USE CLASS AA (AE) CAST-IN-PLACE CONCRETE EXCEPT WHERE NOTED OTHERWISE.
6. HORIZONTAL DIMENSIONS ARE PLAN. VERTICAL DIMENSIONS ARE PLUMB.

DESIGN DATA

HL-93 IN ACCORDANCE WITH AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, FOURTH EDITION AND INTERIMS. SEISMIC DESIGN IN ACCORDANCE WITH MCEER/ATC 49.

CAST-IN-PLACE CONCRETE:	f'c = 4,000 psi; fy (REINF.) = 60,000 psi; n = 8
PRESTRESSED CONCRETE:	f'c = 8,500 psi; f'ci = 7,500 psi; 0.6" DIA. GRADE 270 LOW RELAXATION STRAND; fy (NONPRESTRESSED) = 60,000 psi; n = 6
STRUCTURAL STEEL:	fy = 36,000 psi (DRAIN GRATES)
WEARING SURFACE:	½" CONCRETE; 35 psf (FUTURE)
DESIGN SPEED:	45 mph DIXIE DRIVE
SEISMIC:	SEISMIC DESIGN PARAMETERS (2475 YR RETURN PERIOD, 3% PE IN 75 YRS) PGA = PEAK GROUND ACCELERATION = 0.22g S_S= MAX CONSIDERED EQ GROUND MOTION AT 0.2s = 0.52g S_1= MAX CONSIDERED EQ GROUND MOTION AT 1.0s = 0.17g SEISMIC PERFORMANCE LEVEL = LIFE SAFETY SITE CLASS D, SHL = IV, SDR = 4
TRAFFIC DATA:	2030 ADT = XX,XXX
PARAPET TEST LEVEL:	TL-4

QUANTITIES

ITEM	ESTIMATED	UNIT	AS CONST.

UTAH DEPARTMENT OF TRANSPORTATION
SALT LAKE CITY, UTAH
STRUCTURES DIVISION

DIXIE DRIVE INTERCHANGE
DIXIE DRIVE SPI OVER I-15 - ALT. 1A
SITUATION & LAYOUT 1

DESIGN	AFY		CHECK
DRAWN	JMD	10/08	CHECK
QUANT.			CHECK

APPROVAL RECOMM. — SENIOR DESIGN ENGR. — DATE
APPROVED FOR USE BY UDOT — UDOT BRIDGE ENGR. — DATE

REVISIONS

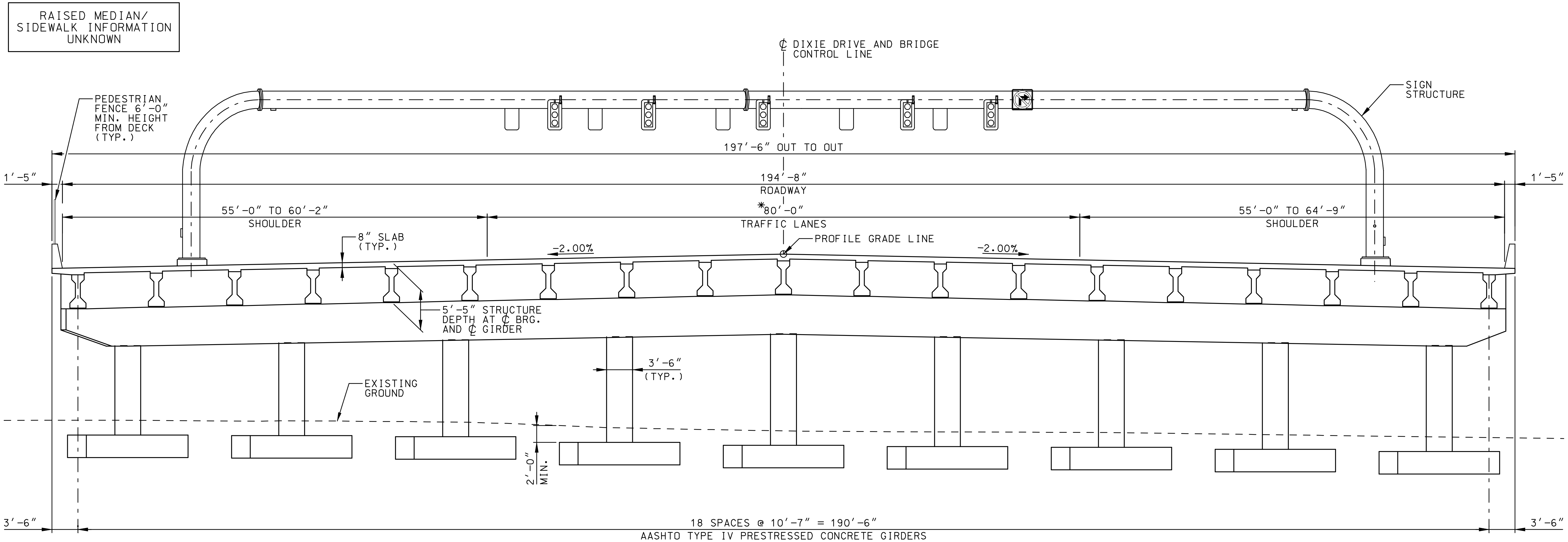
NO.	DATE	BY	REMARKS

PROJECT NUMBER S-I15-1(77)6

UTAH COUNTY

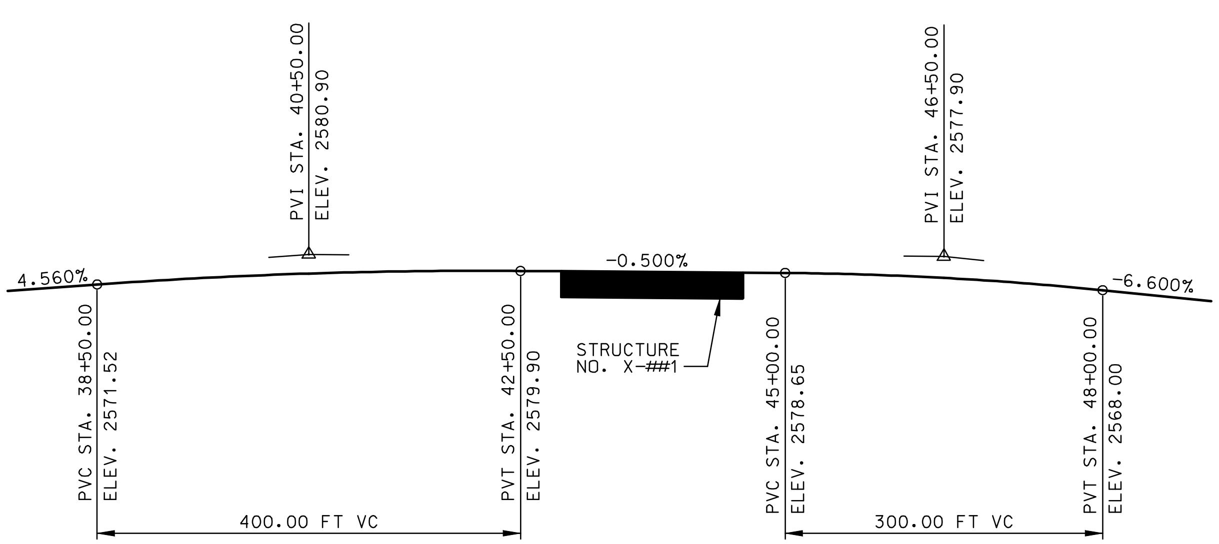
X-##1 DRG. NO.

SHT. 1 OF 2

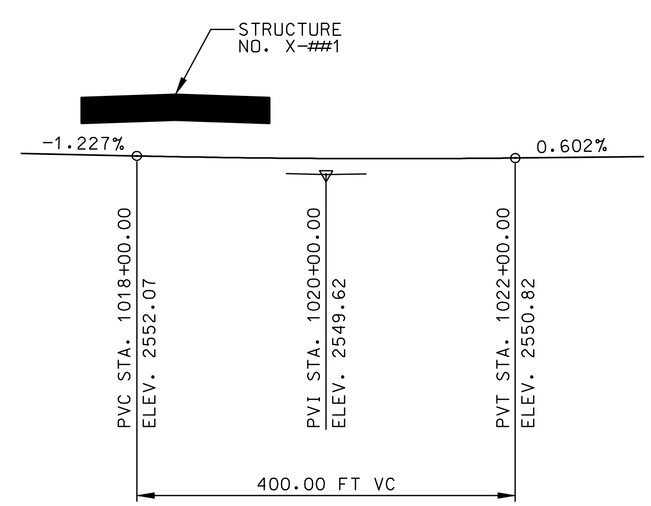


SECTION THRU STRUCTURE

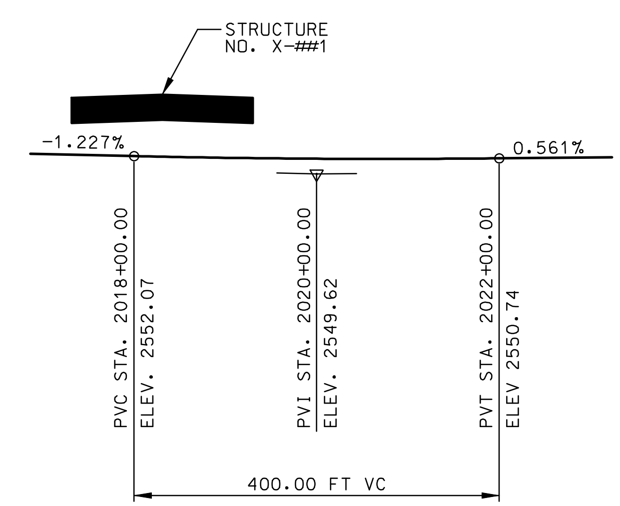
(LOOKING AHEAD STATION)
*NORMAL TO DIXIE DRIVE ALIGNMENT



DIXIE DRIVE PROFILE



I-15 SB PROFILE



I-15 NB PROFILE

NO.	DATE	BY	REVISIONS / REMARKS

UTAH DEPARTMENT OF TRANSPORTATION
SALT LAKE CITY, UTAH
STRUCTURES DIVISION

DESIGN AFY | CHECK
DRAWN JMD 10/08 | CHECK
QUANT. | CHECK

APPROVAL RECOMM. | DATE | SENIOR DESIGN ENGR.
APPROVED FOR USE BY UDOT | DATE | UDOT BRIDGE ENGR.

DIXIE DRIVE INTERCHANGE
DIXIE DRIVE SPI OVER I-15 - ALT. 1A
SITUATION & LAYOUT 2

PROJECT NUMBER S-I15-1(77)6

UTAH
COUNTY

X-##1
DRG. NO.

SHT. 2 OF 2

HORROCKS ENGINEERS
ONE WEST MAIN
P.O. BOX 377
AMERICAN FORK, UTAH 84003
(801) 763-5100

Project: Dixie Drive EA
Subject: Dixie Drive over I-15
Job No.:
Client:
By: AFY
Chk'd By:
Sheet:
Date: 10/08
Date:

Preliminary Cost Estimate

Submitted By: Mike Dobry, S.E.
Prepared By: AJ Yates

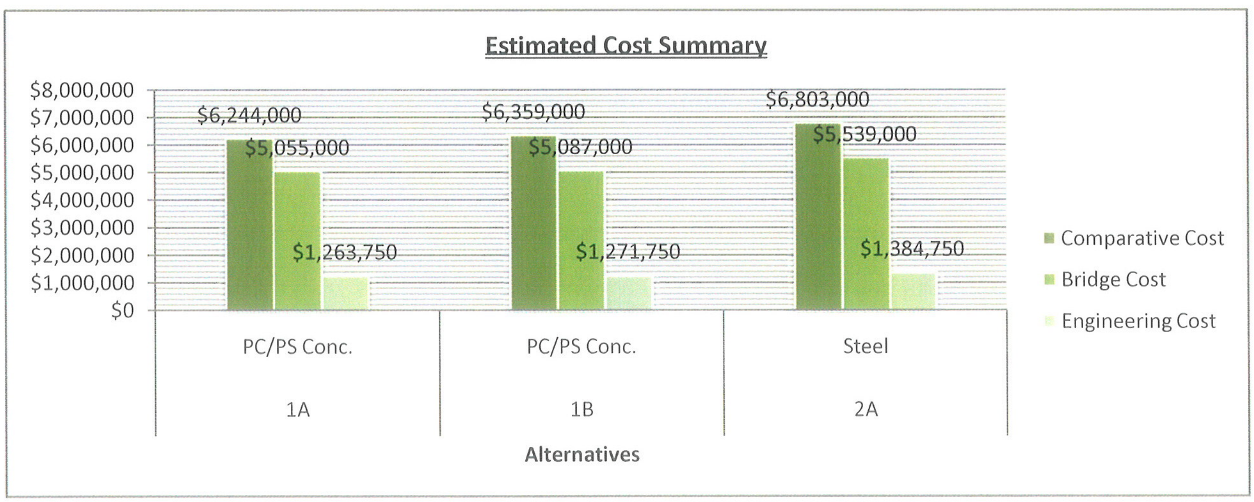
Project Title: Dixie Drive Interchange EA
Project Number: S-I15-1(77)6
Structure: Dixie Drive SPI over I-15

Alternatives:
1A - 2 Span Bridge with AASHTO Type IV PC/PS Concrete Girders
1B - 2 Span Bridge with AASHTO Type V PC/PS Concrete Girders
2A - 2 Span Bridge with Haunched Steel Girders

Contingency: 10%

Est. Cost Summary:

Alternative	1A	1B	2A
Structure Type	PC/PS Conc.	PC/PS Conc.	Steel
Comparative Cost	$6,244,000	$6,359,000	$6,803,000
Bridge Cost	$5,055,000	$5,087,000	$5,539,000
Engineering Cost	$1,263,750	$1,271,750	$1,384,750
Cost per Deck Area	$146	$147	$160



Preliminary Cost Estimate cont.

Alternative: 1A - 2 Span Bridge with AASHTO Type IV PC/PS Concrete Girders

Deck Area: 34,661 ft^2

Cost Per ft^2 of Deck: $146

Item	Unit Cost	Unit	Quantity	Cost
Structural Concrete	$600	CY	2,764	$1,658,413
Reinforcing Steel - Coated	$1.70	LB	552,804	$939,767
Drilled Shafts (36" Diameter)	$350	FT	1,600	$560,000
Granular Backfill Borrow (Plan Quantity)	$60	CY	750	$45,000
Prestressed Concrete Members (x'-x" Type IV)	$340	FT	3,276	$1,113,812
Structural Steel	$2.80	LB	1,092	$3,058
Expansion Joint	$250	FT	437	$109,167
Deck Sealer	$3.00	SY	5,400	$16,201
Electrical Work Birdge	$25,000	LUMP	1	$25,000
Bridge Aesthetics	$125,000	LUMP	1	$125,000

Total Estimated Bridge Cost:	$4,595,417
10% Contingency:	$459,542
Estimated Probable Bridge Construction Cost:	$5,054,959
Estimated Design Engineering Cost:	$505,500
Estimated Construction Engineering Cost:	$758,250
Total Bridge Construction Cost:	$6,318,709
Estimated Construction and Excavation Savings:	-$75,000
Comparative Cost:	$6,244,000

Alternative: 1B - 2 Span Bridge with AASHTO Type V PC/PS Concrete Girders

Deck Area: 34,661 ft^2

Cost Per ft^2 of Deck: $147

Item	Unit Cost	Unit	Quantity	Cost
Structural Concrete	$600	CY	2,928	$1,756,705
Reinforcing Steel - Coated	$1.70	LB	585,568	$995,466
Drilled Shafts (36" Diameter)	$350	FT	1,600	$560,000
Granular Backfill Borrow (Plan Quantity)	$60	CY	750	$45,000
Prestressed Concrete Members (x'-x" Type IV)	$360	FT	2,759	$993,120
Structural Steel	$2.80	LB	1,092	$3,058
Expansion Joint	$250	FT	437	$109,167
Deck Sealer	$3.00	SY	3,851	$11,554
Electrical Work Birdge	$25,000	LUMP	1	$25,000
Bridge Aesthetics	$125,000	LUMP	1	$125,000

Total Estimated Bridge Cost:	$4,624,070
10% Contingency:	$462,407
Estimated Probable Bridge Construction Cost:	$5,087,000
Estimated Design Engineering Cost:	$508,700
Estimated Construction Engineering Cost:	$763,050
Total Bridge Construction Cost:	$6,358,750
Estimated Construction and Excavation Savings:	$0
Comparative Cost:	$6,359,000

Alternative: 2A - 2 Span Bridge with Haunched Steel Girders

Deck Area: 34,661 ft^2

Cost Per ft^2 of Deck: $160

Item	Unit Cost	Unit	Quantity	Cost
Structural Concrete	$600	CY	2,374	$1,424,120
Reinforcing Steel - Coated	$1.70	LB	474,707	$807,001
Drilled Shafts (36" Diameter)	$350	FT	1,600	$560,000
Granular Backfill Borrow (Plan Quantity)	$60	CY	750	$45,000
Structural Steel	$2.80	LB	583,139	$1,632,788
Expansion Joint	$250	FT	1,600	$400,000
Deck Sealer	$3.00	SY	5,400	$16,201
Electrical Work Birdge	$25,000	LUMP	1	$25,000
Bridge Aesthetics	$125,000	LUMP	1	$125,000

Total Estimated Bridge Cost:	$5,035,110
10% Contingency:	$503,511
Estimated Probable Bridge Construction Cost:	$5,539,000
Estimated Design Engineering Cost:	$553,900
Estimated Construction Engineering Cost:	$830,850
Total Bridge Construction Cost:	$6,923,750
Estimated Construction and Excavation Savings:	-$120,833
Comparative Cost:	$6,803,000

BRIDGE 2: DIXIE DRIVE OVER CONVENTION CENTER DRIVE PROPOSED STRUCTURE

DESCRIPTION

The large vertical separation between Dixie Drive and Convention Center Drive requires large embankments. Buried structures handle these types of grade separated crossing very well. A CONSPAN or BEBO Arch bridge system as manufactured by CONTECH was considered. These tunnels are precast arch units placed on cast-in-place abutments. A traditional PC/PS concrete bridge was used to compare and evaluate costs.

Dixie Drive and the I-15 on ramp diverge above the crossing. They are both on vertical curves and horizontal tangents. The edge of tunnel or deck follows the alignments. A typical girder-slab bridge would need a splayed girder to handle the deck taper.

Constructability

The extension of Dixie Drive is a new road. There is minimal traffic along Convention Center Drive. Traffic impacts at this structure are negligible. The contractor should have adequate space to construct within the new right-of-way.

ABC methods can decrease the construction duration of the Dixie Drive embankment. The CONSPAN or BEBO Arch bridge units are precast and can be quickly erected before the MSE walls are placed. Access to the pedestrian trail can also be routed underneath.

Long Term Maintenance/Inspection

UDOT has limited experience with this type of buried superstructure. Recently, these types of structures have been allowed under mainline interstates. Manufacturer's information, independent reports, and government agencies support use of these. Inspections will be similar compared to other buried structures.

Foundations

A formal geotechnical analysis has not been performed. Local conditions favor drilled shafts or spread footings. Drilled shafts under PC/PS bridge abutments are anticipated. Spread footings are anticipated for the arch. MSE walls will retain embankment in both options.

SUPERSTRUCTURE TYPE ANALYSIS AND COMPARISON

Three structure alternatives were considered. Differences in MSE wall quantities were taken into account but the total amount of wall is not reflected in the cost along with a 10% contingency was applied to the bridge cost. A 10% design engineering and 15% construction engineering cost was applied as well.

The estimated deck area is 8,880 ft^2. Estimated costs include the cost of girders, arch units, deck and haunches, diaphragms, parapets, deck sealants, approach slabs, sleeper slabs, abutments, bents, drilled shafts, backfill borrow, electrical work, and bridge aesthetics.

Steel wide flange standard shapes were considered for girders but the cost difference eliminated this option. PC/PS voided cell concrete box sections were also considered but eliminated due to structural limitations with span length.

Alternative 1A – PC/PS AASHTO Type III Girders

The superstructure consists of 12 composite AASHTO Type III girders with a cast-in-place concrete deck. Abutments utilize integral diaphragms. Wingwalls and MSE walls retain the embankment behind the abutments.

Advantages of this alternative are cost reliability and low maintenance issues. Standard formwork can be used and fabrication time is short. PC/PS girder bridges are traditional UDOT structures and require little maintenance.

Disadvantages are girder camber can vary from what is anticipated, and difficult inspection access since the superstructure is much higher than typical grade separations.

Estimated Probable Construction Cost:	$1.91M
	$215/ft^2 of deck
Estimated Design and Construction Engineering Cost:	$478,000
Estimated Construction and Excavation Savings:	$0
Comparative Cost:	$2.39M

Alternative 2A – PC CONSPAN or BEBO Arch Buried Structure

The superstructure consists of 36 precast arch units that form a buried structure. Continuation of the ramp MSE walls will retain the embankment.

Advantages of this alternative are a smaller structure and reduced foundation costs. Since the entire bridge is buried a spread footing abutment can be used instead of expensive drilled shafts. There is also no deck to maintain or replace. Life cycle costs are minimal.

Disadvantages are inspection access only to the underside and less confidence based on historical precedence. Rehabilitation of these structures is not possible. Replacement is the only option which requires considerable earthwork and retaining wall replacement.

Estimated Probable Construction Cost:	$1.29M
Estimated Design and Construction Engineering Cost:	$323,000M
Estimated Construction and Excavation Savings:	$-106,000
Comparative Cost:	$1.51M

Alternative 3A – Rolled Shape Weathering Steel Girders

This superstructure consists of 12 W 40x167 weathering steel girders with a cast-in-place concrete deck. This alternative was quickly eliminated by cost considerations.

Estimated Probable Construction Cost:	$2.09M
	$235/ft^2 of deck
Estimated Design and Construction Engineering Cost:	$523,000
Estimated Construction and Excavation Savings:	$-61,000
Comparative Cost:	$2.55M

ALTERNATIVE COMPARISON SUMMARY

The CONSPAN or Bebo Arch buried structure (Alternative 2A) is the least cost alternative. The structure is only cost effective if spread footings are permissible. A formal geotechnical investigation during the final design process will ascertain foundation limitations. The alternatives rank, according to cost, as follows:

Rank	Alternative	Alternative Description	Comparative Cost
1	2A	PC CONSPAN or BEBO Arch Buried Structure	$1.51M
2	1A	PC/PS AASHTO Type III Girders	$2.39M
3	3A	Rolled Shape Weathering Steel Girders	$2.55M

Alternative 1A is less economical because of its foundation costs. The design life of the new structure is 75 years based on manufacturer's recommendations. The total estimated cost of the least cost alternative is $1.62 million.

See following for preliminary situation and layout sheets and a summary of quantities.

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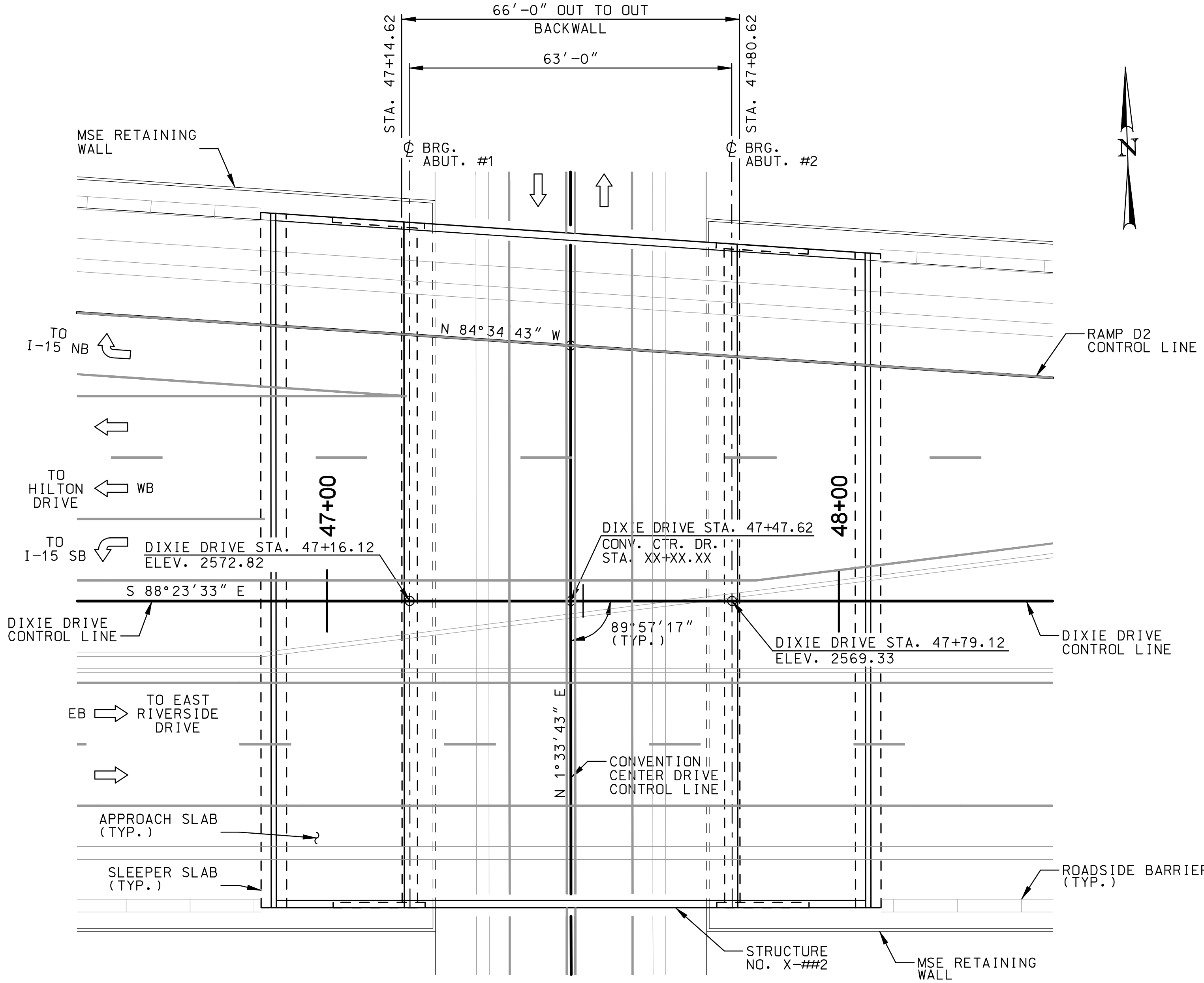
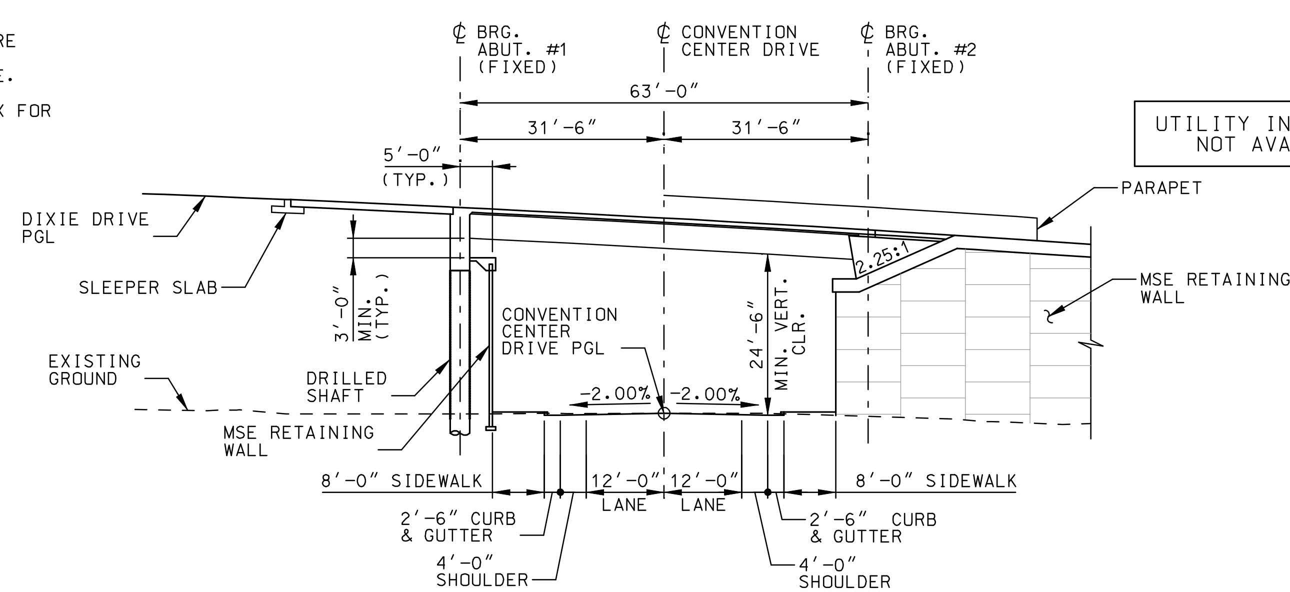


PLAN

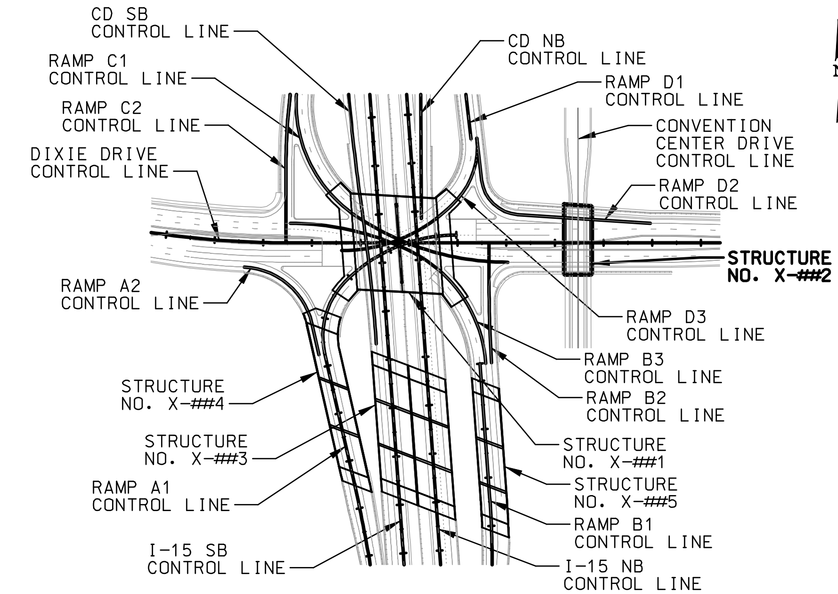
NOTES:

1. ABUTMENTS ARE PARALLEL TO N 1°33'43" E.
2. SEE SHEET XX FOR UTILITIES.



ELEVATION

NORMAL TO CONVENTION CENTER DRIVE



LOCATION PLAN

INDEX OF SHEETS

GENERAL NOTES

1. USE COATED DEFORMED BILLET-STEEL BARS CONFORMING TO AASHTO M 284 OR M 111 AND M 31 GRADE 60 FOR ALL REINFORCING STEEL.
2. USE STRUCTURAL STEEL CONFORMING TO AASHTO M 270 GRADE 36 EXCEPT WHERE NOTED OTHERWISE.
3. CHAMFER ALL EXPOSED CONCRETE CORNERS 3/4" EXCEPT WHERE NOTED OTHERWISE.
4. PROVIDE 2" CONCRETE COVER TO REINFORCING STEEL EXCEPT WHERE NOTED OTHERWISE.
5. USE CLASS AA (AE) CAST-IN-PLACE CONCRETE EXCEPT WHERE NOTED OTHERWISE.
6. HORIZONTAL DIMENSIONS ARE PLAN. VERTICAL DIMENSIONS ARE PLUMB.

DESIGN DATA

HL-93 IN ACCORDANCE WITH AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, FOURTH EDITION AND INTERIMS. SEISMIC DESIGN IN ACCORDANCE WITH MCEER/ATC 49.

CAST-IN-PLACE CONCRETE:	$f'c$ = 4,000 psi; fy (REINF.) = 60,000 psi; n = 8
PRESTRESSED CONCRETE:	$f'c$ = 7,500 psi; $f'ci$ = 6,500 psi; 0.6" DIA. GRADE 270 LOW RELAXATION STRAND; fy (NONPRESTRESSED) = 60,000 psi; n = 6
STRUCTURAL STEEL:	fy = 36,000 psi (DRAIN GRATES)
WEARING SURFACE:	1/2" CONCRETE; 35 psf (FUTURE)
DESIGN SPEED:	45 mph DIXIE DRIVE
SEISMIC:	SEISMIC DESIGN PARAMETERS (2475 YR RETURN PERIOD. 3% PE IN 75 YRS) PGA = PEAK GROUND ACCELERATION = 0.22g S_S= MAX CONSIDERED EQ GROUND MOTION AT 0.2 = 0.52g S_1= MAX CONSIDERED EQ GROUND MOTION AT 1.0 = 0.17g SEISMIC PERFORMANCE LEVEL = LIFE SAFETY SITE CLASS D, SHL = IV, SDR = 4
TRAFFIC DATA:	2030 ADT = XX,XXX
PARAPET TEST LEVEL:	TL-4

QUANTITIES

ITEM	ESTIMATED	UNIT	AS CONST.

NO.	DATE	BY	REMARKS

REVISIONS

UTAH DEPARTMENT OF TRANSPORTATION
SALT LAKE CITY, UTAH
STRUCTURES DIVISION

DESIGN	AFY		CHECK
DRAWN	JMD	10/08	CHECK
QUANT.			CHECK

APPROVAL RECOMM. — DATE — SENIOR DESIGN ENGR.
APPROVED FOR USE BY UDOT — DATE — UDOT BRIDGE ENGR.

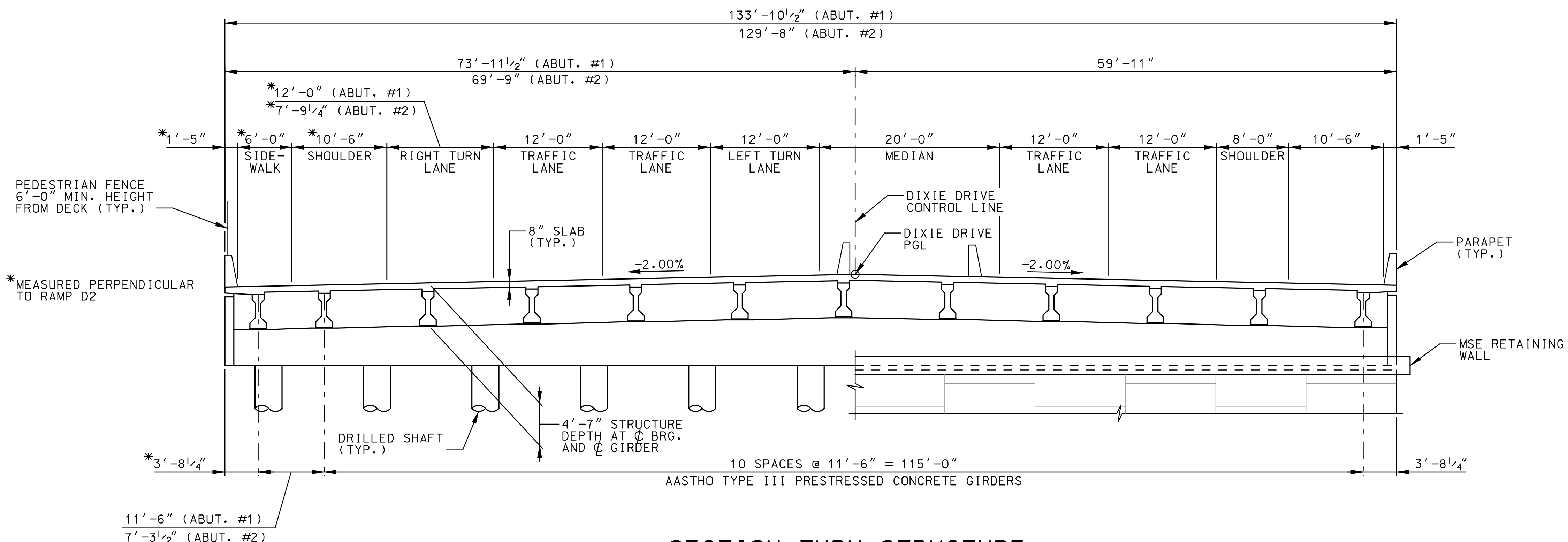
DIXIE DRIVE INTERCHANGE
DIXIE DR. OVER CONV. CTR. DRIVE - ALT. 1A
SITUATION & LAYOUT 1

PROJECT NUMBER S-I15-1(77)6

UTAH
COUNTY

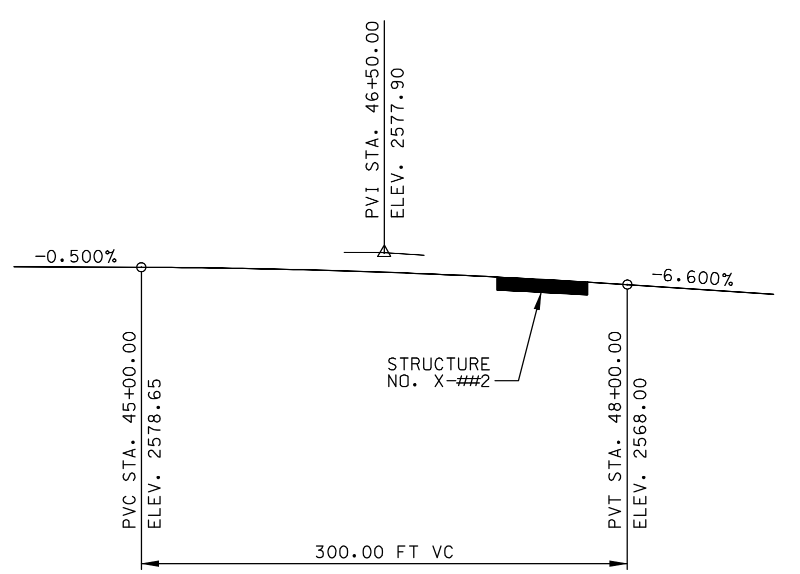
X-##2
DRG. NO.

SHT. 1 OF 2



SECTION THRU STRUCTURE

(LOOKING AHEAD STATION; DIMENSIONS PERPENDICULAR TO DIXIE DRIVE CONTROL LINE UNLESS NOTED OTHERWISE)



DIXIE DRIVE PROFILE

REVISIONS

NO.	DATE	BY	REMARKS

UTAH DEPARTMENT OF TRANSPORTATION
SALT LAKE CITY, UTAH
STRUCTURES DIVISION

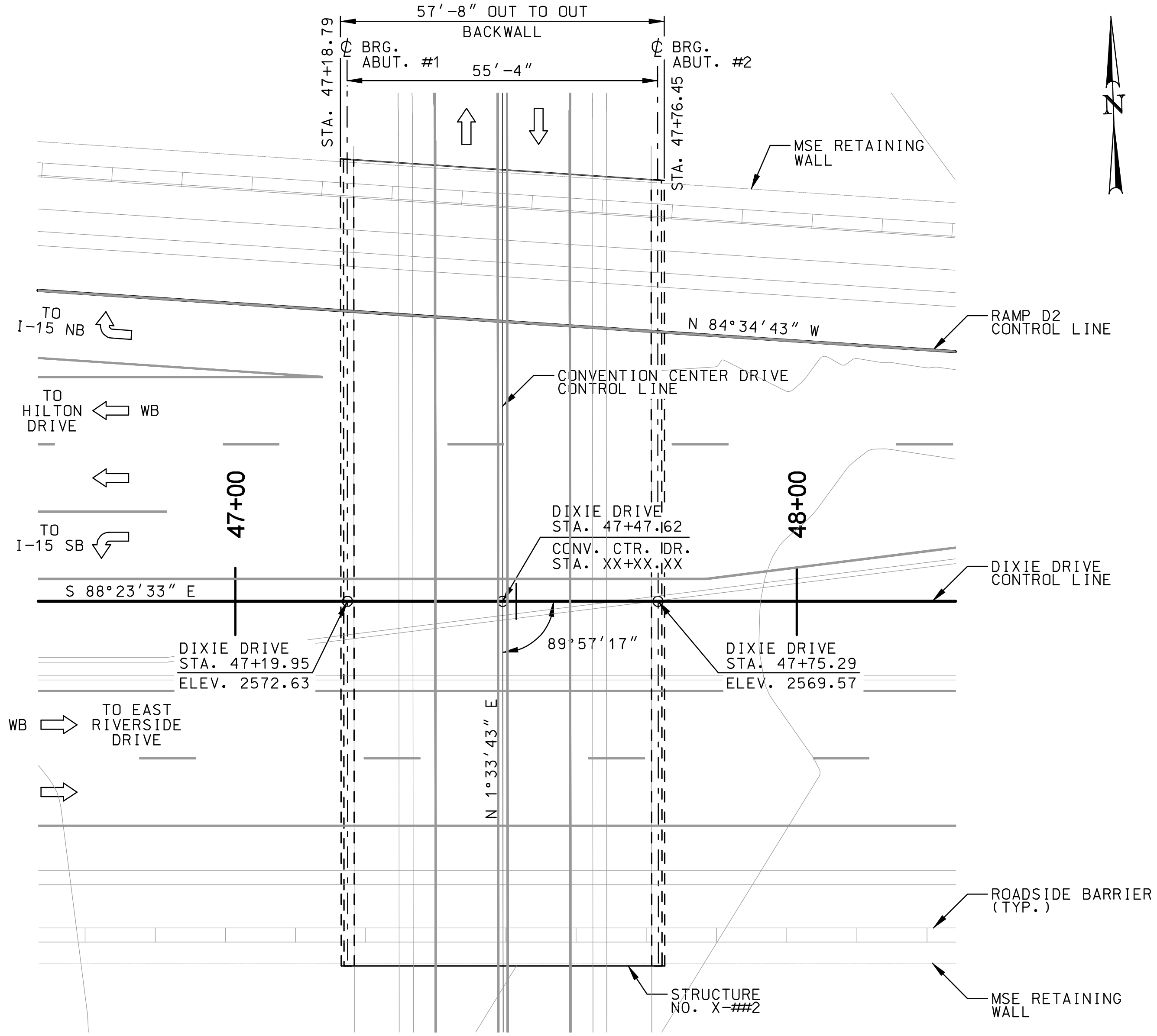
DESIGN AFY CHECK
DRAWN JMD 10/08 CHECK
QUANT. CHECK

APPROVAL RECOMM. DATE SENIOR DESIGN ENGR.
APPROVED FOR USE BY UDOT DATE UDOT BRIDGE ENGR.

DIXIE DRIVE INTERCHANGE
DIXIE DR. OVER CONV. CTR. DRIVE - ALT. 1A
SITUATION & LAYOUT 2

PROJECT NUMBER S-I15-1(77)6

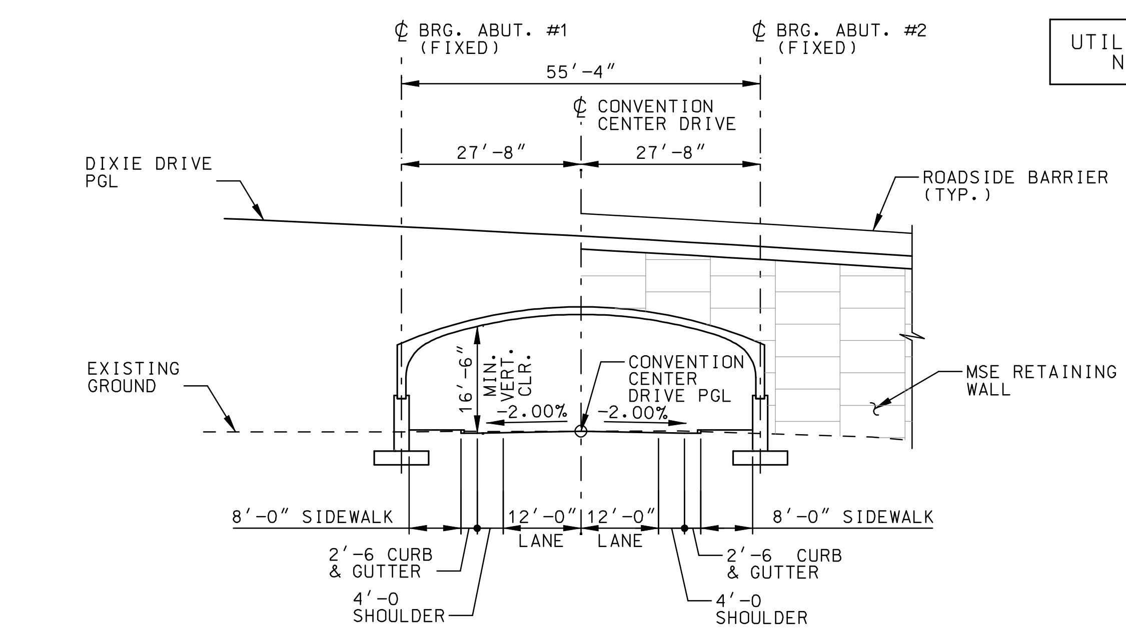
UTAH
COUNTY
X-##2
DRG. NO.
SHT. 2 OF 2



PLAN

NOTES:

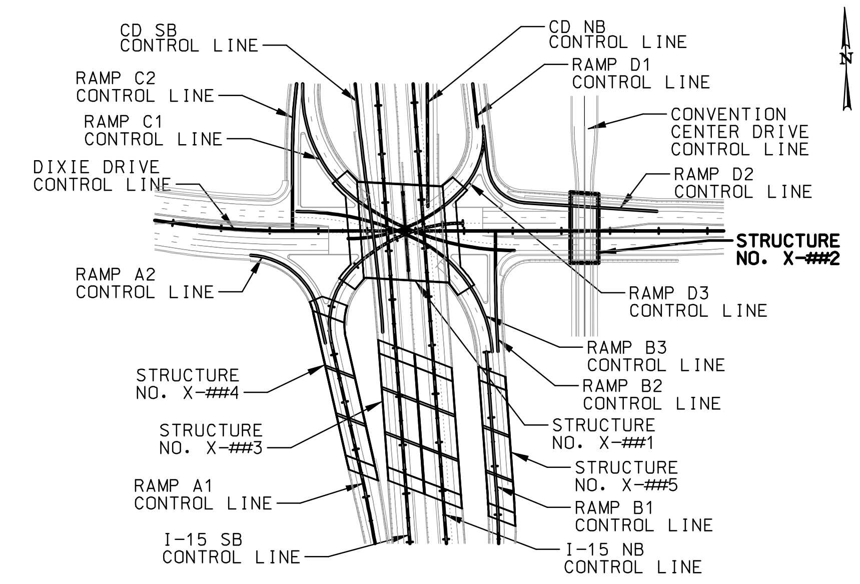
1. ABUTMENTS ARE PARALLEL TO N 1°33'43" E.
2. SEE SHEET XX FOR UTILITIES.



ELEVATION

NORMAL TO CONVENTION CENTER DRIVE

UTILITY INFORMATION NOT AVAILABLE



LOCATION PLAN

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3. PROVIDE 2" CONCRETE COVER TO REINFORCING STEEL EXCEPT WHERE NOTED OTHERWISE.
4. USE CLASS AA (AE) CAST-IN-PLACE CONCRETE EXCEPT WHERE NOTED OTHERWISE.
5. HORIZONTAL DIMENSIONS ARE PLAN. VERTICAL DIMENSIONS ARE PLUMB.

DESIGN DATA

HL-93 IN ACCORDANCE WITH AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, FOURTH EDITION AND INTERIMS. SEISMIC DESIGN IN ACCORDANCE WITH MCEER/ATC 49.

CAST-IN-PLACE CONCRETE:	f'c = 4,000 psi; fy (REINF.) = 60,000 psi; n = 8
DESIGN SPEED:	45 mph DIXIE DRIVE
SEISMIC:	SEISMIC DESIGN PARAMETERS (2475 YR RETURN PERIOD. 3% PE IN 75 YRS) PGA = PEAK GROUND ACCELERATION = 0.22g Ss= MAX CONSIDERED EQ GROUND MOTION AT 0.2s = 0.52g S1= MAX CONSIDERED EQ GROUND MOTION AT 1.0s = 0.17g SEISMIC PERFORMANCE LEVEL = LIFE SAFETY SITE CLASS D, SHL = IV, SDR = 4
TRAFFIC DATA:	2030 ADT = XX,XXX

QUANTITIES

ITEM	ESTIMATED	UNIT	AS CONST.

NO.	DATE	BY	REMARKS

REVISIONS

UTAH DEPARTMENT OF TRANSPORTATION
SALT LAKE CITY, UTAH
STRUCTURES DIVISION

DESIGN AFY CHECK
DRAWN JMD 10/08 CHECK
QUANT. CHECK

APPROVAL RECOMM. DATE SENIOR DESIGN ENGR.
APPROVED FOR USE BY UDOT DATE UDOT BRIDGE ENGR.

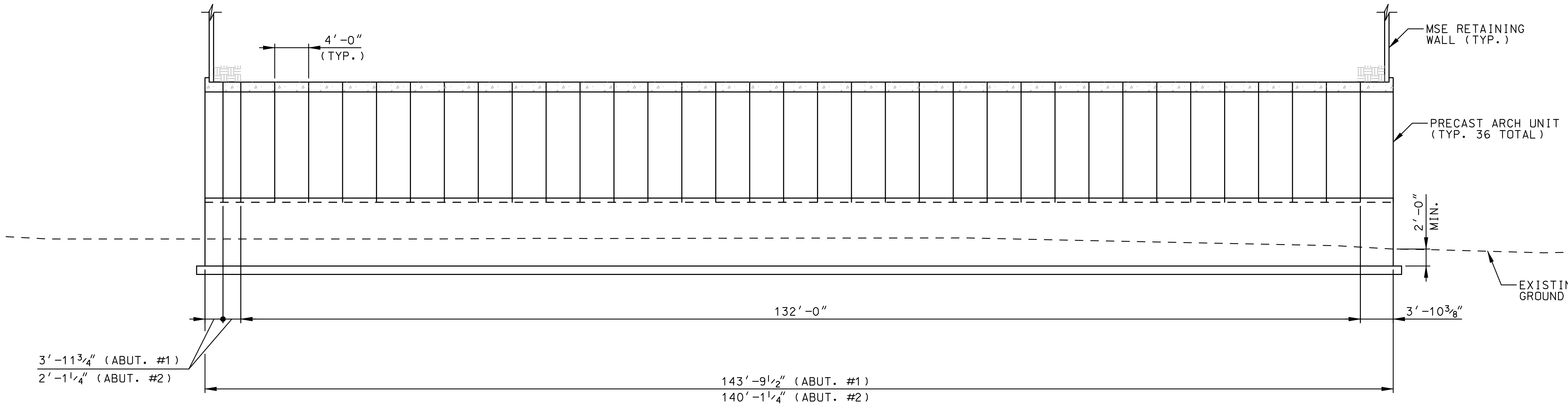
DIXIE DRIVE INTERCHANGE
DIXIE DR. OVER CONV. CTR. DRIVE - ALT. 2A
SITUATION & LAYOUT 1

PROJECT NUMBER S-I15-1(77)6

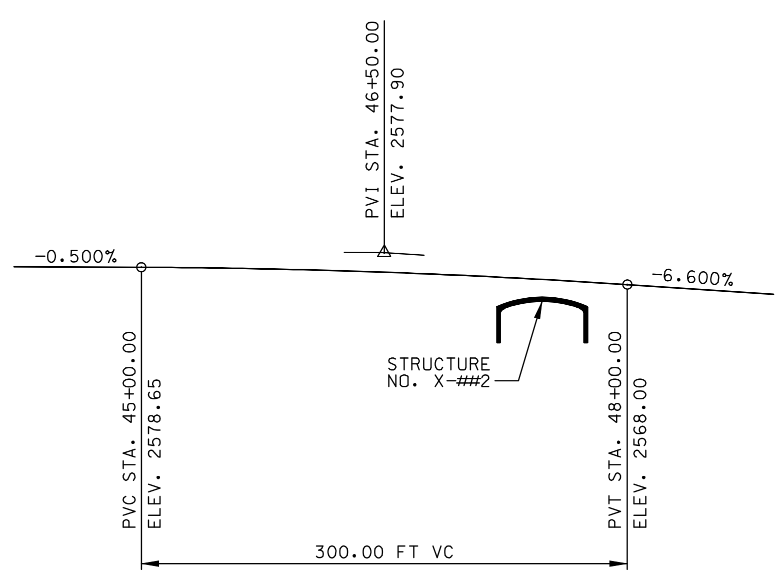
UTAH COUNTY

X-##2
DRG. NO.

SHT. 1 OF 2



SECTION THRU STRUCTURE



DIXIE DRIVE PROFILE

REVISIONS

NO.	DATE	BY	REMARKS

UTAH DEPARTMENT OF TRANSPORTATION
SALT LAKE CITY, UTAH
STRUCTURES DIVISION

DESIGN AFY — CHECK
DRAWN JMD 10/08 — CHECK
QUANT. — CHECK

APPROVAL RECOMM. — DATE — SENIOR DESIGN ENGR.
APPROVED FOR USE BY UDOT — DATE — UDOT BRIDGE ENGR.

DIXIE DRIVE INTERCHANGE
DIXIE DR. OVER CONV. CTR. DRIVE - ALT. 2A
SITUATION & LAYOUT 2

PROJECT NUMBER S-I15-1(77)6

UTAH
COUNTY

X-##2
DRG. NO.

SHT. 2 OF 2

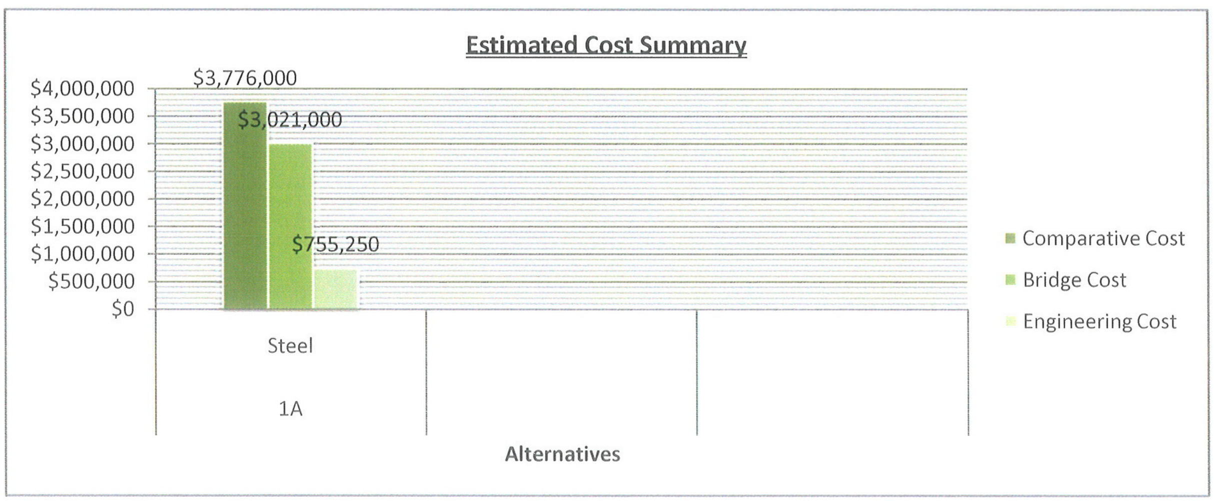
2/19/2009 2:10:01 PM AlanY

Preliminary Cost Estimate

Submitted By:	Mike Dobry, S.E.
Prepared By:	AJ Yates
Project Title:	Dixie Drive Interchange EA
Project Number:	S-I15-1(77)6
Structure:	I-15 Mainline over The Santa Clara River
Alternatives:	1A - Three Span Bridge with Wide Flange Girders
Contingency:	10%

Est. Cost Summary:

Alternative	1A
Structure Type	Steel
Comparative Cost	$3,776,000
Bridge Cost	$3,021,000
Engineering Cost	$755,250
Cost per Deck Area	$179



Preliminary Cost Estimate cont.

Alternative: 1A - Three Span Bridge with Wide Flange Girders

Deck Area: 16,912 ft^2

Cost Per ft^2 of Deck: $179

Item	Unit Cost	Unit	Quantity	Cost
Structural Concrete	$600	CY	1,377	$826,301
Reinforcing Steel - Coated	$1.70	LB	344,292	$585,297
Drilled Shafts (36" Diameter)	$450	FT	1,260	$567,000
Granular Backfill Borrow (Plan Quantity)	$60	CY	800	$48,000
Structural Steel	$2.80	LB	169,040	$473,311
Expansion Joint	$250	FT	420	$105,000
Deck Sealer	$3.00	SY	1,879	$5,637
Electrical Work Birdge	$10,000	LUMP	1	$10,000
Bridge Aesthetics	$125,000	LUMP	1	$125,000

Total Estimated Bridge Cost: $2,745,547
10% Contingency: $274,555

Estimated Probable Bridge Construction Cost: $3,021,000
Estimated Design Engineering Cost: $302,100
Estimated Construction Engineering Cost: $453,150
Total Bridge Construction Cost: $3,776,250

Estimated Construction and Excavation Savings: $0
Comparative Cost: $3,776,000

BRIDGE 3: I-15 MAINLINE OVER THE SANTA CLARA PROPOSED STRUCTURE

DESCRIPTION

These structures are multi-span girder-slab bridges. The out-to-out bridge width is 74′-10″ for the northbound (NB) bridge and 72′-10″ for the southbound (SB) bridge with a total length of 232′-3″. These bridge spans allow for a future travel lane in the I-15 median. I-15 is on a horizontal tangent and vertical crest curve at the structure. There is a standard -2% cross slope away from the control line of I-15. There is a 2″ separation between bridge decks.

The existing structures have vertical wall abutments with retaining walls for bridge embankment. To reduced constriction of the channel, spill thru type abutments will be used. There is significant constriction of the channel at the bridges and a shallow superstructure depth is required. The bridges will have 2′ minimum of freeboard above the required 100-yr water surface elevation. As stated previously, raising the I-15 profile is not an option.

Constructability

A crossover is anticipated to shift I-15 traffic to one side. Temporary bridge widening or phased bridge construction will allow traffic to be relocated during construction. The contractor can also use the on and off ramps that run parallel to I-15 as an alternate traffic detour. Traditional scheduling and construction techniques can be used in either case.

Potential ABC methods for this structure are precast substructures and deck panels. Total construction duration can be decreased by rapid substructure erection before paving operations. Full or partial depth precast deck panels can reduce construction duration but are typically more expensive and have a shorter life span than a traditional deck.

This project is anticipated to use the Construction Management/General Contractor (CMGC) method of contracting so that the contractor will be consulted on preferred construction methods.

Long Term Maintenance/Inspection

Each alternative utilizes closed joints except for expansion joints between the sleeper slabs and approach slabs. Open superstructures are easier to inspect. This bridge type is common for many bridges that span I-15.

Foundations

A formal geotechnical analysis has not been performed. Existing bridge soil logs were reviewed for preliminary recommendations. Local conditions favor drilled shafts or spread footings. Drilled shafts under abutments and bents are anticipated. During final design, consideration will be given to multi-column bents on isolated drilled shafts. Excavation impacts are reduced with this type of bent because the column is an extension of the drilled shaft and caps are not necessary.

Superstructure

Potential superstructure types for this bridge are PC/PS concrete girders or steel girders. Girder depths must meet the freeboard requirements.

SUPERSTRUCTURE TYPE ANALYSIS AND COMPARISON

Only one superstructure type was reasonable due to structure depth limitations. PC/PS AASHTO shape concrete girders are too deep and PC/PS concrete box beams or voided cell beams are inadequate for these spans lengths. A structural steel girder system is the only viable structure type for these bridges and is detailed in the Structure Alternatives section of this report. See Figure 4 for a comparison of girder types and freeboard requirement.

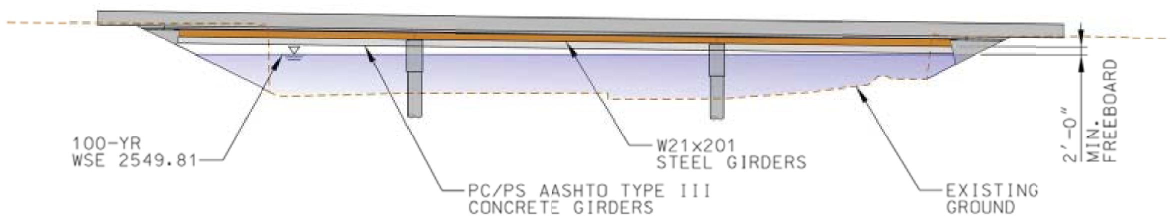


Figure 5 Bridge 3 Girder Type Comparison

Raising the I-15 profile was evaluated. Due to its proximity, the entire Dixie Drive alignment would need to be elevated to meet the minimum vertical clearance underneath the SPI bridge. This option was quickly eliminated due to the increase in earthwork and retaining wall costs.

Retaining walls for bridge embankment are not needed because of the spill through abutments. A 10% contingency was applied to the bridge cost along with a 10% design engineering and 15% construction engineering cost was applied as well.

The estimated deck area is 16,912 ft^2 for each bridge. Estimated costs include the cost of girders, deck and haunches, diaphragms, parapets, deck sealants, approach slabs, sleeper slabs, abutments, bents, drilled shafts, backfill borrow, electrical work, and bridge aesthetics.

Single span options utilizing post tension concrete girders or built-up steel girders were not evaluated because of their significant increase in structure depth and resulting increase in MSE walls and earthwork.

Alternative 1A – Rolled Shape Steel Girder Bridge

The superstructures consist of 11 composite steel W21x201 girders with cast-in-place concrete decks. Wingwalls retain the embankment behind the abutments.

Advantages of this alternative are smaller dead load and a shallower structure depth.

Disadvantages are more complicated fabrication and increased superstructure erection time. There are also increased maintenance issues to monitor corrosion and other environmental effects.

Estimated Probable Construction Cost:	\$3.02M
	\$179/ft^2 of deck
Estimated Design and Construction Engineering Cost:	\$755,000
Estimated Construction and Excavation Savings:	\$0
Comparative Cost*:	\$3.78M

*costs shown are on a per bridge basis

ALTERNATIVE COMPARISON SUMMARY

A three span rolled shape steel girder-slab bridge (Alternative 1A) is the least cost and only feasible alternative. Steel girders are the only structure type that can accommodate the shallow structure depth.

The design life of the new structure is 75 years. The total estimated cost of the recommended alternative is \$3.78 million per bridge. This equates to a total cost per deck area of \$223/ft^2.

See following for preliminary situation and layout sheets and a summary of quantities.

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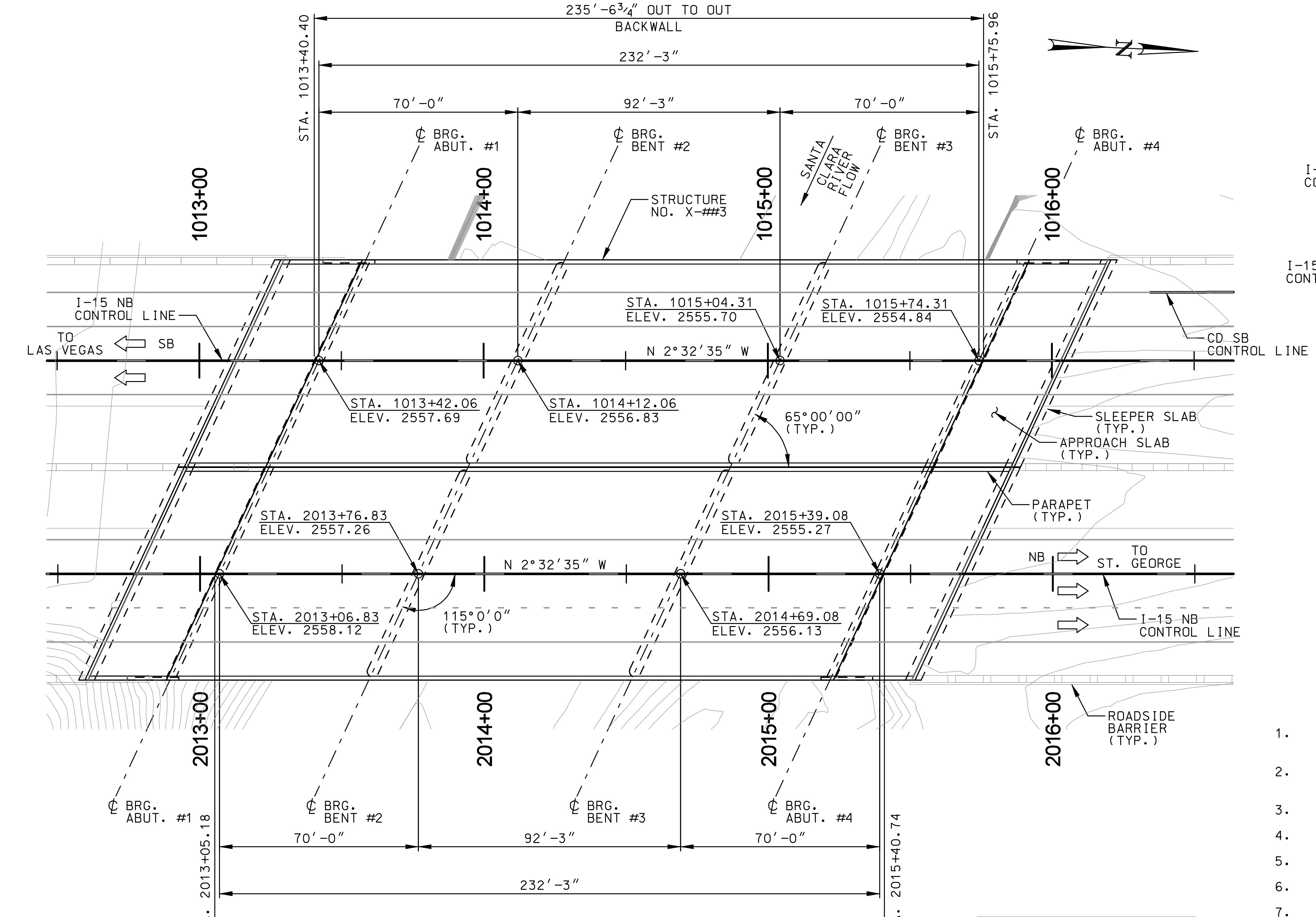
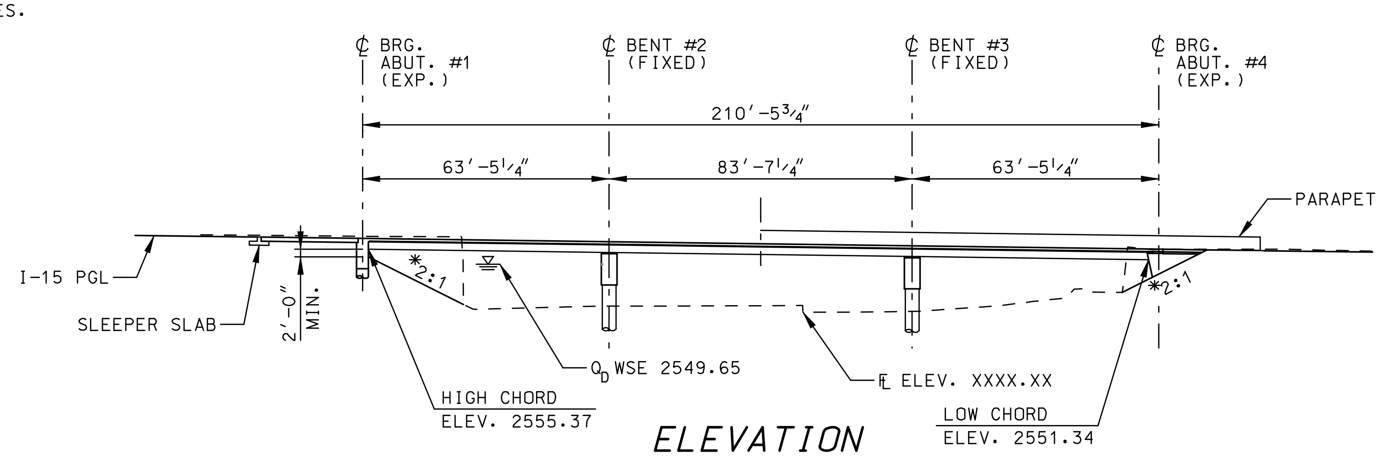


UTILITY INFORMATION
NOT AVAILABLE

PLAN

NOTES:

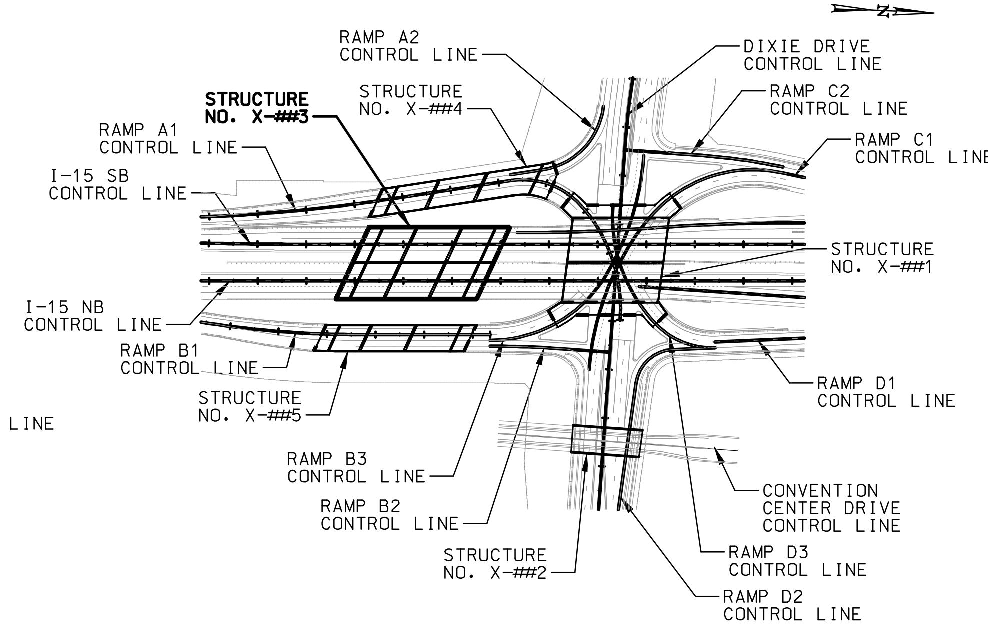
1. ALL SUBSTRUCTURES ARE PARALLEL TO BEARING S 67°32'35" E.
2. SEE SHEET XX FOR UTILITIES.



ELEVATION

NORMAL TO SANTA CLARA

*SLOPE IS PERPENDICULAR TO FRONT FACE OF ABUTMENT



LOCATION PLAN

INDEX OF SHEETS

GENERAL NOTES

1. USE COATED DEFORMED BILLET-STEEL BARS CONFORMING TO AASHTO M 284 OR M 111 AND M 31 GRADE 60 FOR ALL REINFORCING STEEL.
2. USE STRUCTURAL STEEL CONFORMING TO AASHTO M 270 GRADE 50 EXCEPT WHERE NOTED OTHERWISE.
3. CHAMFER ALL EXPOSED CONCRETE CORNERS ¾" EXCEPT WHERE NOTED OTHERWISE.
4. PROVIDE 2" CONCRETE COVER TO REINFORCING STEEL EXCEPT WHERE NOTED OTHERWISE.
5. USE CLASS AA (AE) CAST-IN-PLACE CONCRETE EXCEPT WHERE NOTED OTHERWISE.
6. HORIZONTAL DIMENSIONS ARE PLAN. VERTICAL DIMENSIONS ARE PLUMB.
7. SEE EXISTING STRUCTURE D-673 AND F-314 PLANS FOR ADDITIONAL INFORMATION.

DESIGN DATA

HL-93 IN ACCORDANCE WITH AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, FOURTH EDITION AND INTERIMS. SEISMIC DESIGN IN ACCORDANCE WITH MCEER/ATC 49.

CAST-IN-PLACE CONCRETE:	f'c = 4,000 psi; fy (REINF.) = 60,000 psi; n = 8
STRUCTURAL STEEL:	Fy = 50,000 psi (GIRDERS) Fy = 36,000 psi (DIAPHRAGMS & DRAINS)
WEARING SURFACE:	½" CONCRETE; 35 psf (FUTURE)
DESIGN SPEED:	75 mph I-15
SEISMIC:	SEISMIC DESIGN PARAMETERS (2475 YR RETURN PERIOD. 3% PE IN 75 YRS) PGA = PEAK GROUND ACCELERATION = 0.22 g Ss= MAX CONSIDERED EQ GROUND MOTION AT 0.2s = 0.52 g S1= MAX CONSIDERED EQ GROUND MOTION AT 1.0s = 0.17 g SEISMIC PERFORMANCE LEVEL = LIFE SAFETY SITE CLASS D, SHL = IV, SDR = 4
TRAFFIC DATA:	2030 ADT = XX,XXX
PARAPET TEST LEVEL:	TL-4

QUANTITIES

ITEM	ESTIMATED	UNIT	AS CONST.

NO.	DATE	BY	REVISIONS	REMARKS

UTAH DEPARTMENT OF TRANSPORTATION
SALT LAKE CITY, UTAH
STRUCTURES DIVISION

DESIGN AFY CHECK
DRAWN JMD 10/08 CHECK
QUANT. CHECK

APPROVAL RECOMM. DATE SENIOR DESIGN ENGR.
APPROVED FOR USE BY UDOT DATE UDOT BRIDGE ENGR.

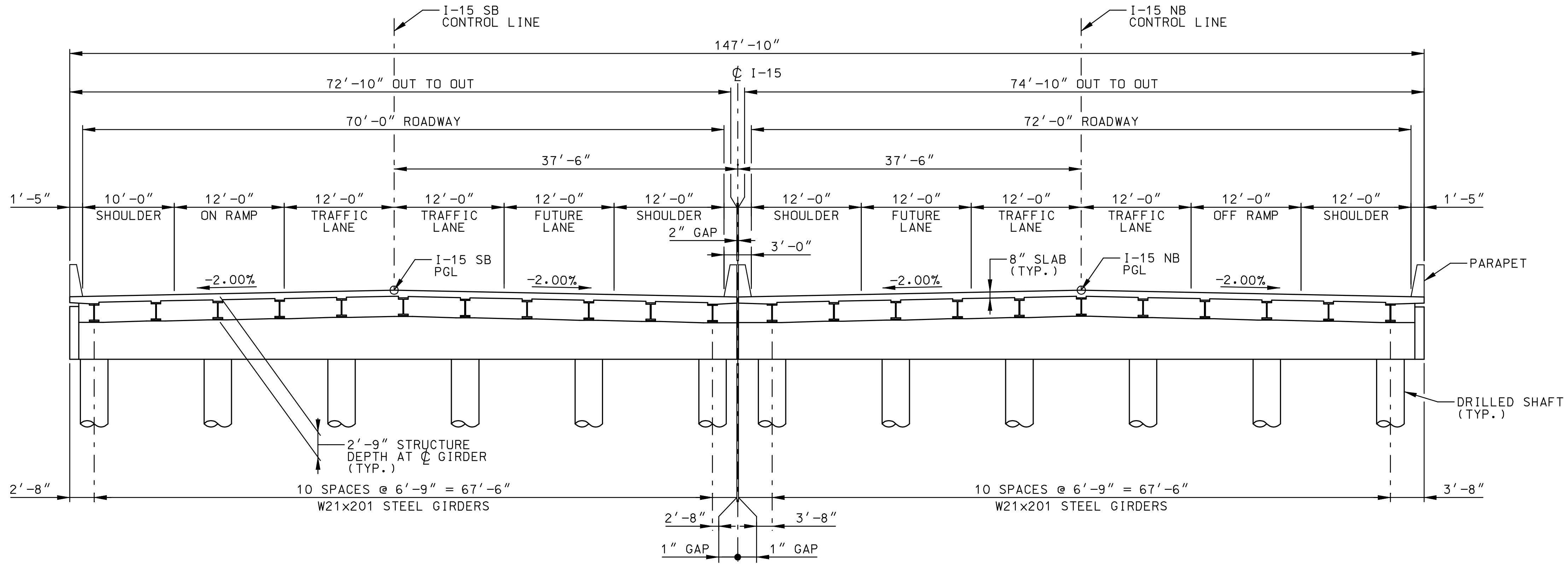
DIXIE DRIVE INTERCHANGE
I-15 OVER SANTA CLARA RIVER - ALT. 1A
SITUATION & LAYOUT 1

PROJECT NUMBER S-I15-1(77)6

UTAH
COUNTY

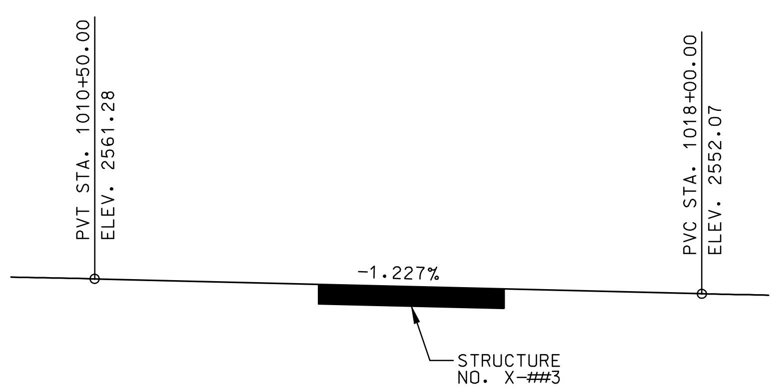
X-##3
DRG. NO.

SHT. 1 OF 2

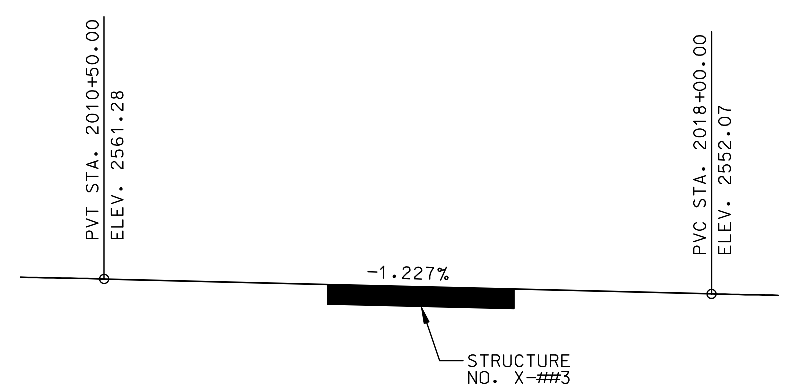


SECTION THRU STRUCTURE

(LOOKING AHEAD STATION; DIMENSIONS PERPENDICULAR TO I-15 NB OR I-15 SB CONTROL LINE)



I-15 SB PROFILE



I-15 NB PROFILE

HYDRAULIC DATA

GENERAL INFORMATION:
DRAINAGE AREA = XXXX sq mi
FLOWLINE ELEVATION AT APPROACH SECTION = XXXX.XX ft
FLOWLINE ELEVATION AT BRIDGE SECTION = XXXX.XX ft

DESIGN INFORMATION (Q_D):
DESIGN FREQUENCY = 100 yr
DESIGN DISCHARGE = 13,000 ft^3/s
UNCONSTRICTED WSE AT APPROACH SECTION = 2549.32 ft
CONSTRICTED WSE AT APPROACH SECTION = 2549.65 ft
VELOCITY THROUGH BRIDGE SECTION = 6.5 ft/s

100-YEAR FLOOD EVENT (Q_{100}):
100-YEAR DISCHARGE = 13,000 ft^3/s
UNCONSTRICTED WSE AT APPROACH SECTION = 2549.32 ft
CONSTRICTED WSE AT APPROACH SECTION = 2549.65 ft
VELOCITY THROUGH BRIDGE SECTION = 6.5 ft/s
DEPTH OF CONTRACTION SCOUR = X.X ft
TOTAL SCOUR DEPTH AT LEFT ABUTMENT = XX.X ft
TOTAL SCOUR DEPTH AT RIGHT ABUTMENT = XX.X ft
TOTAL SCOUR DEPTH AT PIERS = XX.X ft

500-YEAR FLOOD EVENT (Q_{500}):
500-YEAR DISCHARGE = 24,000 ft^3/s
UNCONSTRICTED WSE AT APPROACH SECTION = 2555.13 ft
CONSTRICTED WSE AT APPROACH SECTION = 2555.13 ft
VELOCITY THROUGH BRIDGE SECTION = 7.2 ft/s
DEPTH OF CONTRACTION SCOUR = X.X ft
TOTAL SCOUR DEPTH AT LEFT ABUTMENT = XX.X ft
TOTAL SCOUR DEPTH AT RIGHT ABUTMENT = XX.X ft
TOTAL SCOUR DEPTH AT PIERS = XX.X ft

NO.	DATE	BY	REVISIONS REMARKS

UTAH DEPARTMENT OF TRANSPORTATION
SALT LAKE CITY, UTAH
STRUCTURES DIVISION

DESIGN AFY CHECK
DRAWN JMD 10/08 CHECK
QUANT. CHECK
APPROVAL RECOMM. DATE SENIOR DESIGN ENGR.
APPROVED FOR USE BY UDOT DATE UDOT BRIDGE ENGR.

DIXIE DRIVE INTERCHANGE
I-15 OVER SANTA CLARA RIVER - ALT. 1A
SITUATION & LAYOUT 2

PROJECT NUMBER S-I15-1(77)6

UTAH
COUNTY
X-##3
DRG. NO.

SHT. 2 OF 2

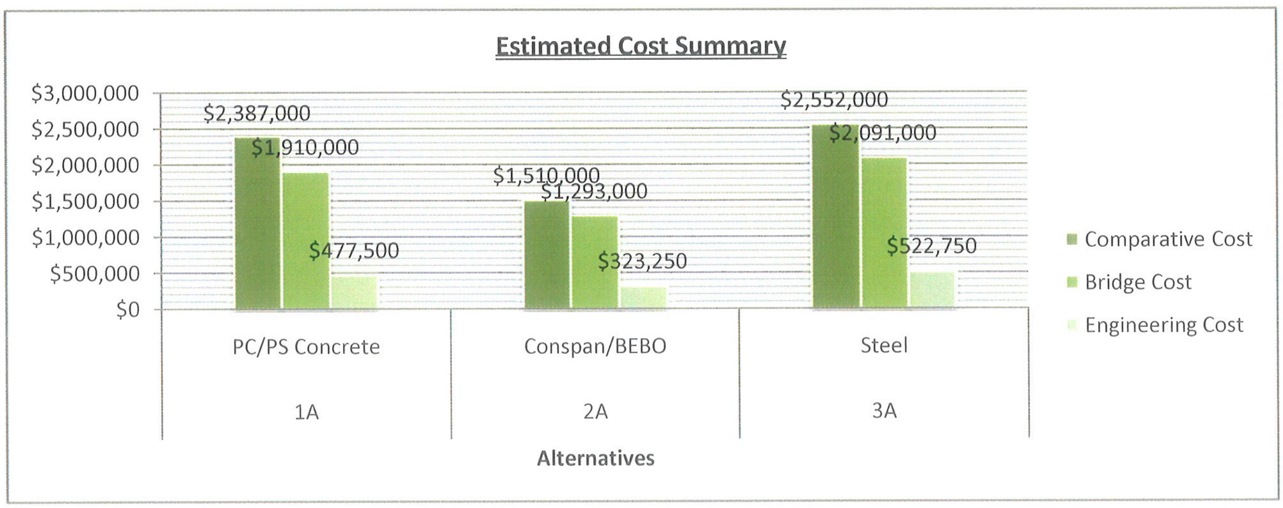
2/19/2009 2:08:09 PM AlanY

Preliminary Cost Estimate

Submitted By:	Mike Dobry, S.E.
Prepared By:	AJ Yates
Project Title:	Dixie Drive Interchange EA
Project Number:	S-I15-1(77)6
Structure:	Dixie Drive over Convention Center Drive
Alternatives:	1A - Single Span Bridge with AASHTO Type III PC/PS Concrete Girders 2A - PC Tunnel with Conspan/BEBO Arches 3A - Single Span Bridge with Rolled Shape Steel Girders
Contingency:	10%

Est. Cost Summary:

Alternative	1A	2A	3A
Structure Type	PC/PS Concrete	Conspan/BEBO	Steel
Comparative Cost	$2,387,000	$1,510,000	$2,552,000
Bridge Cost	$1,910,000	$1,293,000	$2,091,000
Engineering Cost	$477,500	$323,250	$522,750
Cost per Deck Area	$215	$146	$235



Preliminary Cost Estimate cont.

Alternative: 1A - Single Span Bridge with AASHTO Type III PC/PS Concrete Girders

Deck Area: 8,880 ft^2

Cost Per ft^2 of Deck: $215

Item	Unit Cost	Unit	Quantity	Cost
Structural Concrete	$600	CY	978	$586,913
Reinforcing Steel - Coated	$1.70	LB	195,638	$332,584
Drilled Shafts (36" Diameter)	$350	FT	1,200	$420,000
Granular Backfill Borrow (Plan Quantity)	$60	CY	300	$18,000
Prestressed Concrete Members (x'-x" Type III)	$320	FT	756	$241,920
Structural Steel	$2.80	LB	1,092	$3,058
Expansion Joint	$250	FT	282	$70,474
Deck Sealer	$3.00	SY	987	$2,960
Electrical Work Birdge	$10,000	LUMP	1	$10,000
Bridge Aesthetics	$50,000	LUMP	1	$50,000

Total Estimated Bridge Cost:	$1,735,908
10% Contingency:	$173,591
Estimated Probable Bridge Construction Cost:	$1,910,000
Estimated Design Engineering Cost:	$191,000
Estimated Construction Engineering Cost:	$286,500
Total Bridge Construction Cost:	$2,387,500
Estimated Construction and Excavation Savings:	$0
Comparative Cost:	$2,387,000

Alternative: 2A - PC Tunnel with Conspan/BEBO Arches

Item	Unit Cost	Unit	Quantity	Cost
Structural Concrete	$600	CY	239	$143,300
Reinforcing Steel - Coated	$2	LB	59,708	$101,504
Granular Backfill Borrow (Plan Quantity)	$60	CY	1,000	$60,000
Prestressed Concrete Members (x'-x" Type IV)	$20,000	FT	36	$720,000
Electrical Work Birdge	$25,000	LUMP	1	$25,000
Bridge Aesthetics	$125,000	LUMP	0	$125,000

Total Estimated Bridge Cost:	$1,174,805
10% Contingency:	$117,480
Estimated Probable Bridge Construction Cost:	$1,293,000
Estimated Design Engineering Cost:	$129,300
Estimated Construction Engineering Cost:	$193,950
Total Bridge Construction Cost:	$1,616,250
Estimated Construction and Excavation Savings:	-$105,750
Comparative Cost:	$1,510,000

Alternative: 3A - Single Span Bridge with Rolled Shape Steel Girders

Deck Area: 8,880 ft^2

Cost Per ft^2 of Deck: $235

Item	Unit Cost	Unit	Quantity	Cost
Structural Concrete	$600	CY	752	$450,900
Reinforcing Steel - Coated	$1.70	LB	150,300	$255,510
Drilled Shafts (36" Diameter)	$350	FT	1,200	$420,000
Granular Backfill Borrow (Plan Quantity)	$60	CY	300	$18,000
Structural Steel	$2.80	LB	140,330	$392,924
Expansion Joint	$250	FT	1,200	$300,000
Deck Sealer	$3.00	SY	987	$2,960
Electrical Work Birdge	$10,000	LUMP	1	$10,000
Bridge Aesthetics	$50,000	LUMP	1	$50,000

Total Estimated Bridge Cost: $1,900,294
10% Contingency: $190,029

Estimated Probable Bridge Construction Cost: $2,091,000
Estimated Design Engineering Cost: $209,100
Estimated Construction Engineering Cost: $313,650
Total Bridge Construction Cost: $2,613,750

Estimated Construction and Excavation Savings: -$61,100
Comparative Cost: $2,552,000

BRIDGES 4 & 5: I-15 ON AND OFF RAMPS OVER THE SANTA CLARA PROPOSED STRUCTURES

DESCRIPTION

These structures are multi-span girder-slab bridges. The out-to-out bridge width is 54'-10" with a total length of 302'-0" for the on ramp (Bridge 4) and 250'-8" for the off ramp (Bridge 5). A uniform superelevation transition is expected on each bridge.

There are no existing ramp structures. Spill through abutments will be used to match the mainline bridges. Since the ramps are at a higher elevation the span lengths will need to be longer to match the bridge embankment fill slopes. In order to manage scour effects and constriction of the channel, the ramp substructures will be placed in line with the mainline substructures.

Constructability

The new I-15 ramps have no user cost impacts and their order of construction is flexible. However, the contractor can use the on and off ramps that run parallel to I-15 as an alternate traffic detour.

Potential ABC methods include precast substructures and deck panels. Total construction duration can be decreased by rapid substructure erection. Full or partial depth precast deck panels can reduce construction duration but are typically more expensive and have a shorter life span than a traditional deck.

This project is anticipated to use the Construction Management/General Contractor (CMGC) method of contracting so that the contractor will be consulted on preferred construction methods.

Long Term Maintenance/Inspection

These bridges utilize expansion joints at the approach slabs. These open joints require more maintenance and inspection. Open superstructures are relatively easier to inspect. This bridge type is common for many UDOT bridges.

Foundations

A formal geotechnical analysis has not been performed. Existing bridge soil logs were reviewed for preliminary recommendations. Local conditions favor drilled shafts or spread footings. Drilled shafts under abutments and bents are anticipated. During final design, consideration will be given to multi-column bents on isolated drilled shafts. Excavation impacts are reduced with this type of bent because the column is an extension of the drilled shaft and caps are not necessary.

Superstructure

These bridge effectively have unlimited structure depth. PC/PS concrete girders or weathering steel girders are possible superstructure types. Single span options were looked into including spliced post tensioned concrete girders. The span lengths are beyond the reach of these girders. Single span steel girders are not economical due to the extreme span lengths.

SUPERSTRUCTURE TYPE ANALYSIS AND COMPARISON

Only one structure alternative was considered. Single span bridges were not feasible. Two span bridges were ruled out for aesthetic concerns because of the mainline bridges have three spans. PC/PS AASHTO Type V concrete girders are the most economical alternate. Steel girders (as illustrated in previous structures in this report) are not cost effective compared to PC/PS concrete girders in this instance.

Retaining walls for bridge embankment are not needed because of the spill through abutments. A 10% contingency was applied to the bridge cost along with a 10% design engineering and 15% construction engineering cost was applied as well.

The estimated deck area is 15,840 ft^2 for the on ramp and 13,955 ft^2 for the off ramp Estimated costs include the cost of girders, deck and haunches, diaphragms, parapets, deck sealants, approach slabs, sleeper slabs, abutments, bents, drilled shafts, backfill borrow, electrical work, and bridge aesthetics.

I-15 On Ramp Alternative 1A – PC/PS AASHTO Type V Girders

The superstructure consists of 5 composite AASHTO Type V girders with cast-in-place concrete decks. The bents utilize semi-integral diaphragms and abutments have typical integral diaphragms. Wingwalls retain the embankment behind the abutments.

Advantages of this alternative are cost reliability and low maintenance issues. Historically, concrete prices have been more stable and do not inflate as steeply as steel. Standard formwork can be used and fabrication time is short. PC/PS girder bridges are traditional UDOT structures and require little maintenance. Corrosion will not be an issue.

Disadvantages are higher dead loads and girder camber can vary from what is anticipated.

Estimated Probable Construction Cost:	\$2.52M
	\$159/ft^2 of deck
Estimated Design and Construction Engineering Cost:	\$629,000
Estimated Construction and Excavation Savings:	\$0
Comparative Cost:	\$3.14M

I-15 Off Ramp Alternative 1A – PC/PS AASHTO Type V Girders

The superstructure consists of 5 composite AASHTO Type V girders with cast-in-place concrete decks. The bents utilize semi-integral diaphragms and abutments have typical integral diaphragms. Wingwalls retain the embankment behind the abutments.

Advantages of this alternative are cost reliability and low maintenance issues. Historically, concrete prices have been more stable and do not inflate as steeply as steel. Standard formwork can be used and fabrication time is short. PC/PS girder bridges are traditional UDOT structures and require little maintenance. Corrosion will not be an issue.

Disadvantages are higher dead loads and girder camber can vary from what is anticipated.

Estimated Probable Construction Cost:	\$2.37M
	\$170/ft^2 of deck
Estimated Design and Construction Engineering Cost:	\$594,000
Estimated Construction and Excavation Savings:	\$0
Comparative Cost:	\$2.97M

ALTERNATIVE COMPARISON SUMMARY

Three span PC/PS AASHTO Type V concrete girder-slab bridges (Alternative 1A) is the least cost alternative for each ramp. Other alternatives were eliminated without a detailed cost analysis because of span lengths and available structure depths.

The design life of each new structure is 75 years. The total estimated cost of the recommended alternatives is \$3.14 million for the on ramp and \$2.92 for the off ramp. This equates to a cost per deck area of \$198/ft^2 and \$209/ft^2, respectively.

See following for preliminary situation and layout sheets and a summary of quantities.

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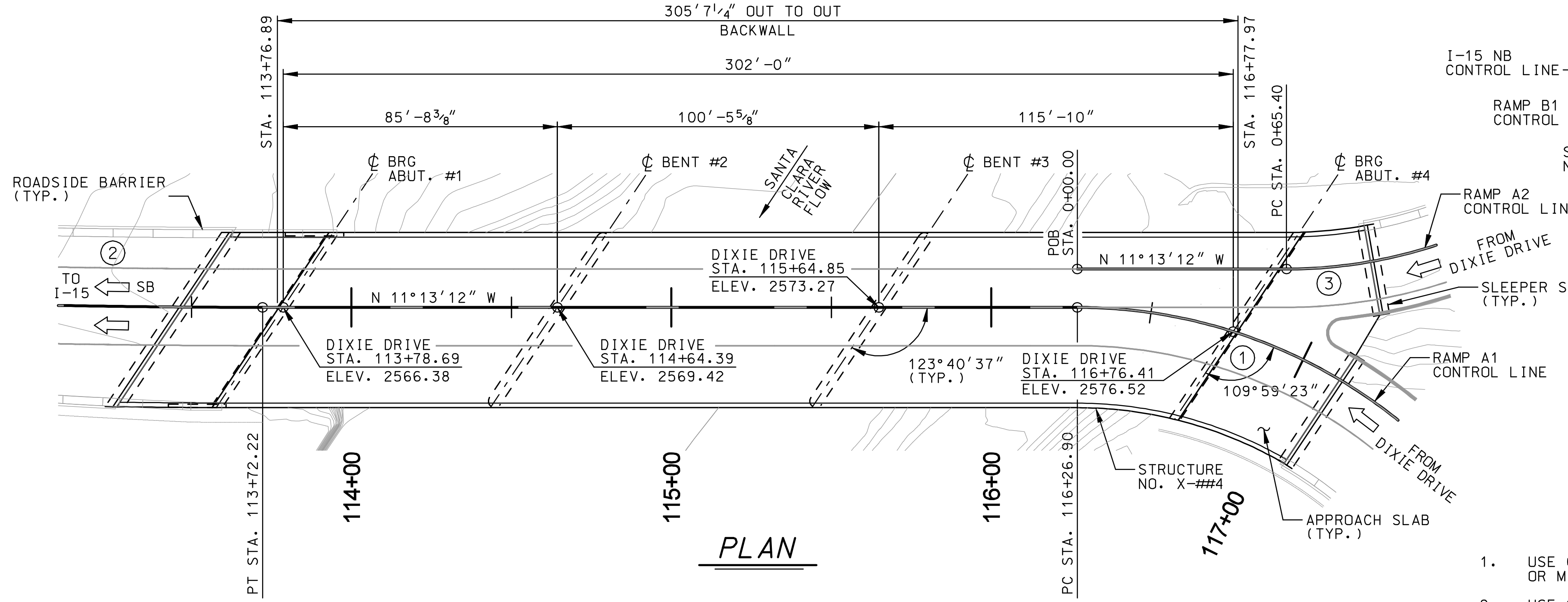
RAMP A1 CURVE DATA (1)	RAMP A1 CURVE DATA (2)	RAMP A2 CURVE DATA (3)
Δ = 57°08′57″ RT.	Δ = 8°41′41″ LT.	Δ = 74°33′51″ LT.
R = 160.00′	R = 3400.00′	R = 150.00′
L = 159.59′	L = 515.95′	L = 195.21′
T = 87.14′	T = 258.47′	T = 114.20′
P.I. STA. 117+14.04	P.I. STA. 111+14.74	P.I. STA. 1+79.60
N = 9999023.49	N = 9998434.67	N = 9999111.84
E = 1032169.21	E = 1032286.01	E = 1032139.45

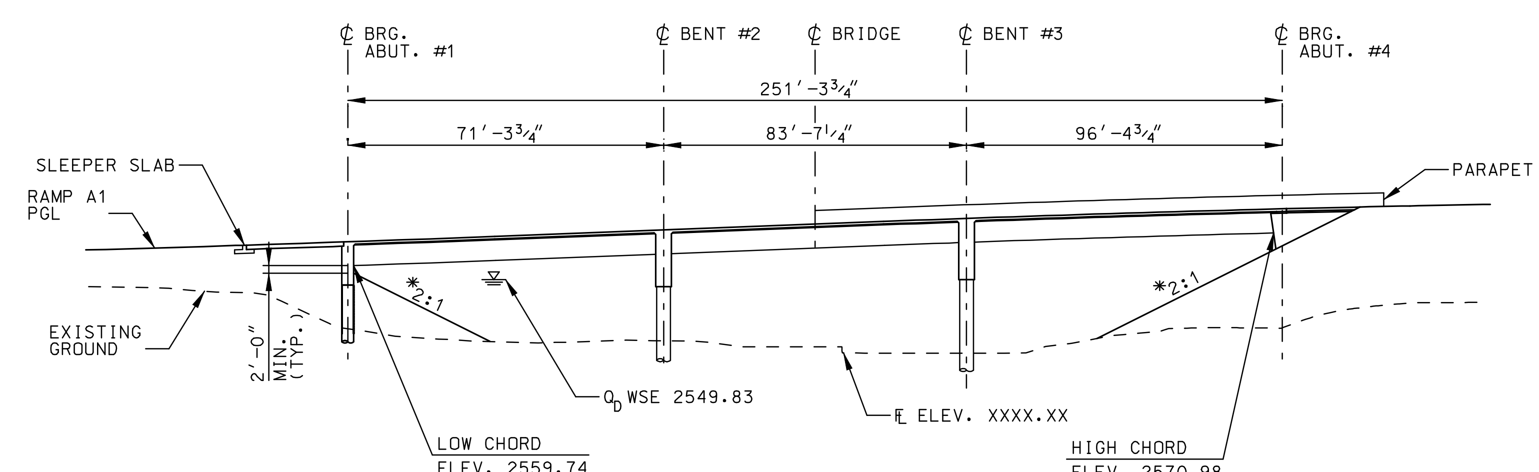


PLAN

NOTES:

1. ALL SUBSTRUCTURES ARE PARALLEL TO BEARING S 67°32′35″ E.
2. SEE SHEET XX FOR UTILITIES.

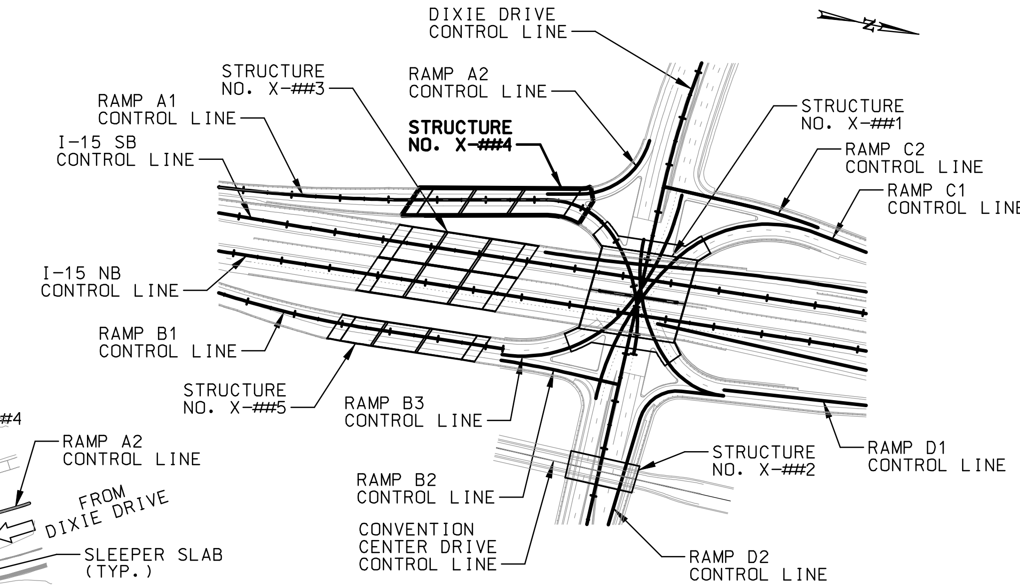
UTILITY INFORMATION NOT AVAILABLE



ELEVATION

NORMAL TO SANTA CLARA

*SLOPE IS PERPENDICULAR TO FRONT FACE OF ABUTMENT



LOCATION PLAN

INDEX OF SHEETS

GENERAL NOTES

1. USE COATED DEFORMED BILLET-STEEL BARS CONFORMING TO AASHTO M 284 OR M 111 AND M 31 GRADE 60 FOR ALL REINFORCING STEEL.
2. USE STRUCTURAL STEEL CONFORMING TO AASHTO M 270 GRADE 36 EXCEPT WHERE NOTED OTHERWISE.
3. CHAMFER ALL EXPOSED CONCRETE CORNERS 3/4″ EXCEPT WHERE NOTED OTHERWISE.
4. PROVIDE 2″ CONCRETE COVER TO REINFORCING STEEL EXCEPT WHERE NOTED OTHERWISE.
5. USE CLASS AA (AE) CAST-IN-PLACE CONCRETE EXCEPT WHERE NOTED OTHERWISE.
6. HORIZONTAL DIMENSIONS ARE PLAN. VERTICAL DIMENSIONS ARE PLUMB.

DESIGN DATA

HL-93 IN ACCORDANCE WITH AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, FOURTH EDITION AND INTERIMS. SEISMIC DESIGN IN ACCORDANCE WITH MCEER/ATC 49.

CAST-IN-PLACE CONCRETE:	f′c = 4,000 psi; fy (REINF.) = 60,000 psi; n = 8
PRESTRESSED CONCRETE:	f′c = 8,500 psi; f′ci = 7,500 psi; 0.6″ DIA. GRADE 270 LOW RELAXATION STRAND; fy (NONPRESTRESSED) = 60,000 psi; n = 6
STRUCTURAL STEEL:	fy = 36,000 psi (DRAIN GRATES)
WEARING SURFACE:	1/2″ CONCRETE; 35 psf (FUTURE)
DESIGN SPEED:	45 mph I-15 ON RAMP
SEISMIC:	SEISMIC DESIGN PARAMETERS (2475 YR RETURN PERIOD, 3% PE IN 75 YRS) PGA = PEAK GROUND ACCELERATION = 0.22 g S_S = MAX CONSIDERED EQ GROUND MOTION AT 0.2s = 0.52 g S_1 = MAX CONSIDERED EQ GROUND MOTION AT 1.0s = 0.17 g SEISMIC PERFORMANCE LEVEL = LIFE SAFETY SITE CLASS D, SHL = IV, SDR = 4
TRAFFIC DATA:	2030 ADT = XX,XXX
PARAPET TEST LEVEL:	TL-4

QUANTITIES

ITEM	ESTIMATED	UNIT	AS CONST.

REVISIONS

NO.	DATE	BY	REMARKS

UTAH DEPARTMENT OF TRANSPORTATION
SALT LAKE CITY, UTAH
STRUCTURES DIVISION

DESIGN AFY | CHECK
DRAWN JMD 10/08 | CHECK
QUANT. | CHECK

APPROVAL RECOMM. | DATE | SENIOR DESIGN ENGR.
APPROVED FOR USE BY UDOT | DATE | UDOT BRIDGE ENGR.

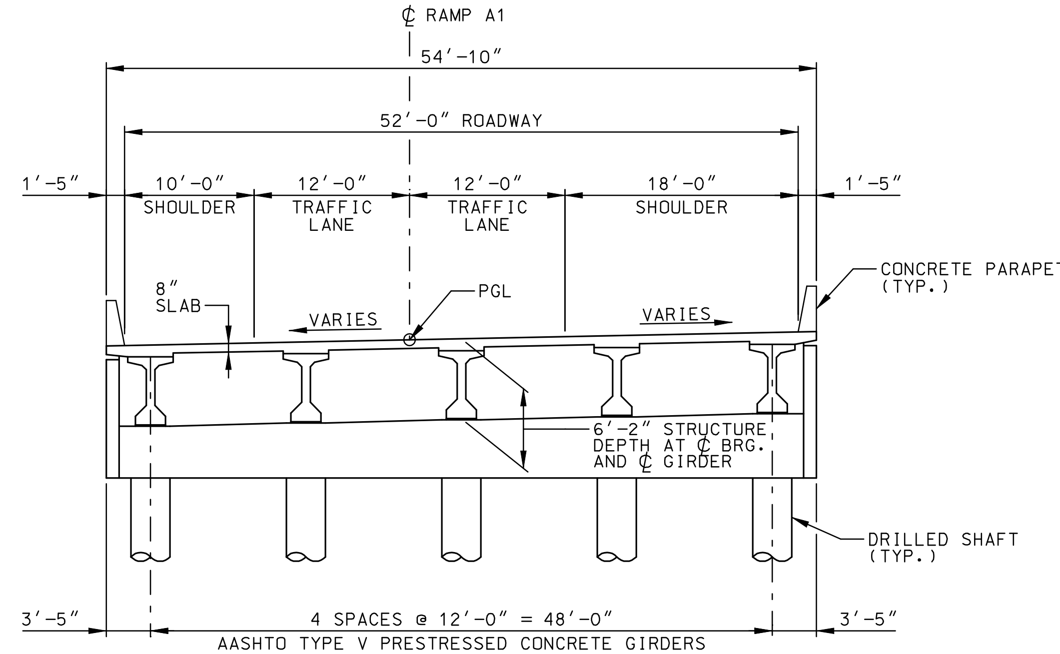
DIXIE DRIVE INTERCHANGE
I-15 ON RAMP OVER SANTA CLARA RIVER - ALT 1A
SITUATION & LAYOUT 1

PROJECT NUMBER S-I15-1(77)6

UTAH COUNTY

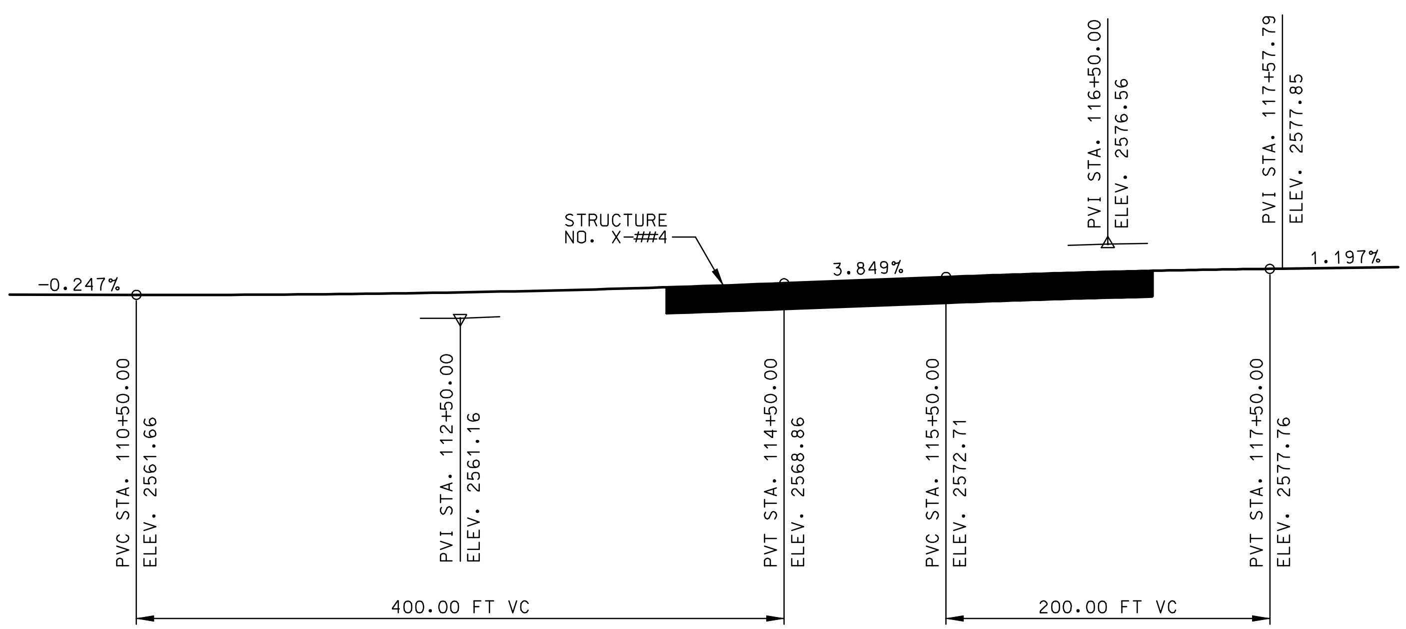
X-##4 DRG. NO.

SHT. 1 OF 2



SECTION THRU STRUCTURE

(LOOKING AHEAD STATION)



RAMP A1 PROFILE

HYDRAULIC DATA

GENERAL INFORMATION:
DRAINAGE AREA = XXXX sq mi
FLOWLINE ELEVATION AT APPROACH SECTION = XXXX.XX ft
FLOWLINE ELEVATION AT BRIDGE SECTION = XXXX.XX ft

DESIGN INFORMATION (Q_D):
DESIGN FREQUENCY = 100 yr
DESIGN DISCHARGE = 13,000 ft^3/s
UNCONSTRICTED WSE AT APPROACH SECTION = 2550.51 ft
CONSTRICTED WSE AT APPROACH SECTION = 2549.83 ft
VELOCITY THROUGH BRIDGE SECTION = 7.2 ft/s

100-YEAR FLOOD EVENT (Q_{100}):
100-YEAR DISCHARGE = 13,000 ft^3/s
UNCONSTRICTED WSE AT APPROACH SECTION = 2550.51 ft
CONSTRICTED WSE AT APPROACH SECTION = 2549.83 ft
VELOCITY THROUGH BRIDGE SECTION = 7.2 ft/s
DEPTH OF CONTRACTION SCOUR = X.X ft
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TOTAL SCOUR DEPTH AT RIGHT ABUTMENT = XX.X ft
TOTAL SCOUR DEPTH AT PIERS = XX.X ft

500-YEAR FLOOD EVENT (Q_{500}):
500-YEAR DISCHARGE = 24,000 ft^3/s
UNCONSTRICTED WSE AT APPROACH SECTION = 2555.88 ft
CONSTRICTED WSE AT APPROACH SECTION = 2554.96 ft
VELOCITY THROUGH BRIDGE SECTION = 8.7 ft/s
DEPTH OF CONTRACTION SCOUR = X.X ft
TOTAL SCOUR DEPTH AT LEFT ABUTMENT = XX.X ft
TOTAL SCOUR DEPTH AT RIGHT ABUTMENT = XX.X ft
TOTAL SCOUR DEPTH AT PIERS = XX.X ft

NO.	DATE	BY	REMARKS
			REVISIONS

UTAH DEPARTMENT OF TRANSPORTATION
SALT LAKE CITY, UTAH
STRUCTURES DIVISION

DESIGN AFY | CHECK
DRAWN JMD 10/08 | CHECK
QUANT. | CHECK

APPROVAL RECOMM. | DATE | SENIOR DESIGN ENGR.
APPROVED FOR USE BY UDOT | DATE | UDOT BRIDGE ENGR.

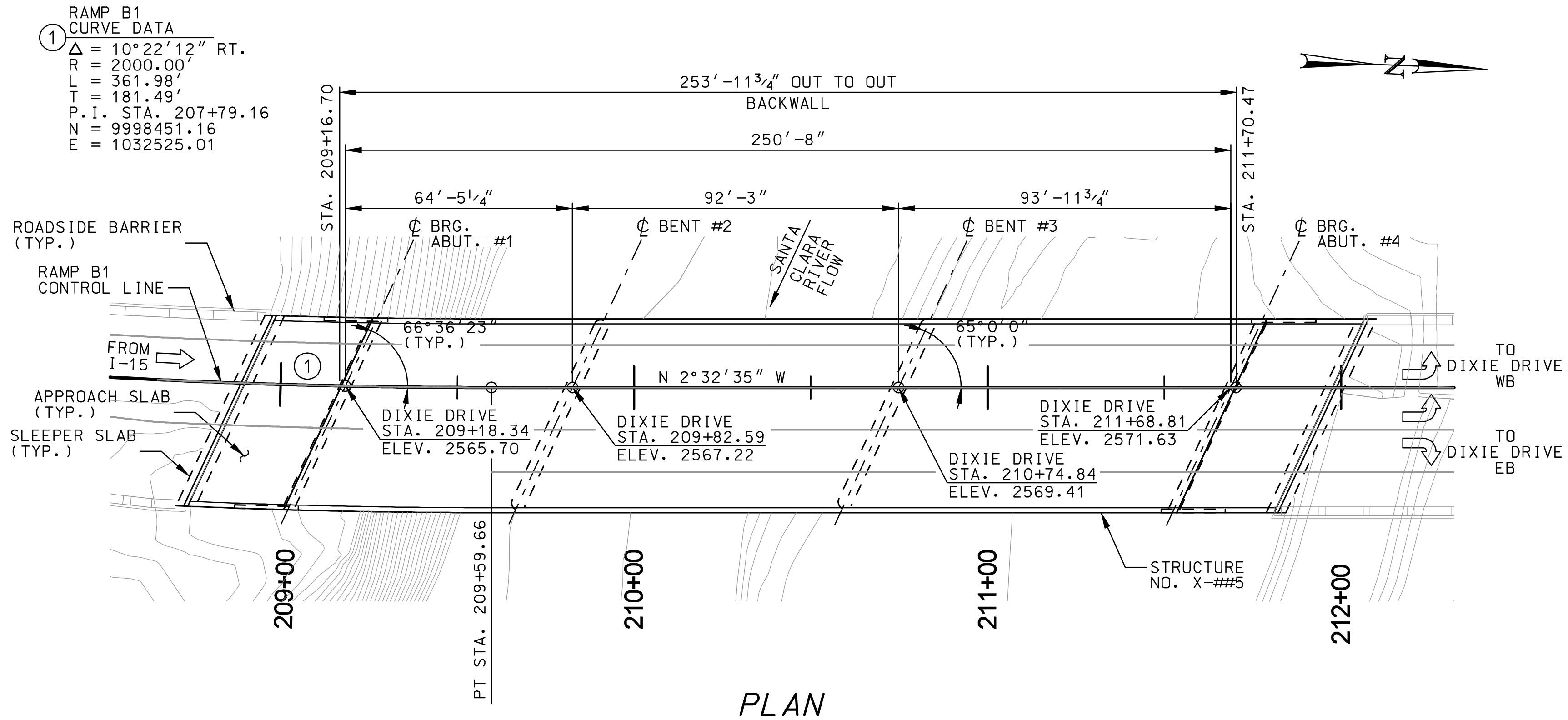
DIXIE DRIVE INTERCHANGE
I-15 ON RAMP OVER SANTA CLARA RIVER - ALT. 1A
SITUATION & LAYOUT 2

PROJECT NUMBER S-I15-1(77)6

UTAH
COUNTY

X-##4
DRG. NO.

SHT. 2 OF 2



PLAN

NOTES:

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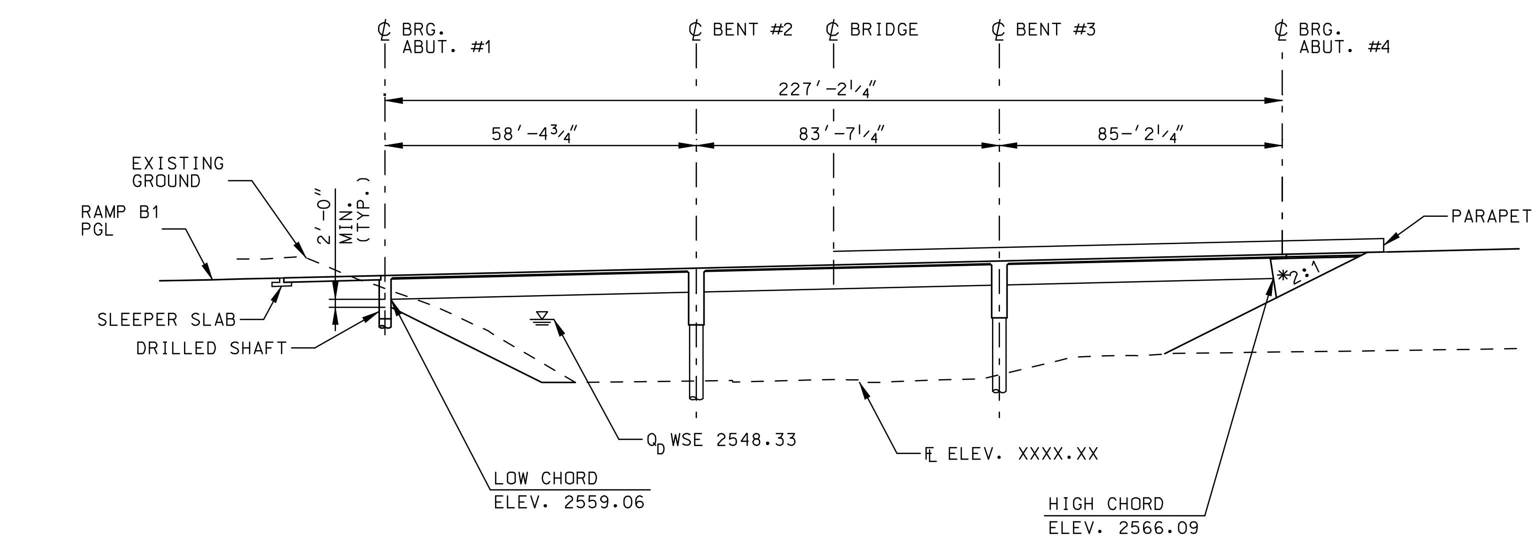
2. SEE SHEET XX FOR UTILITIES.

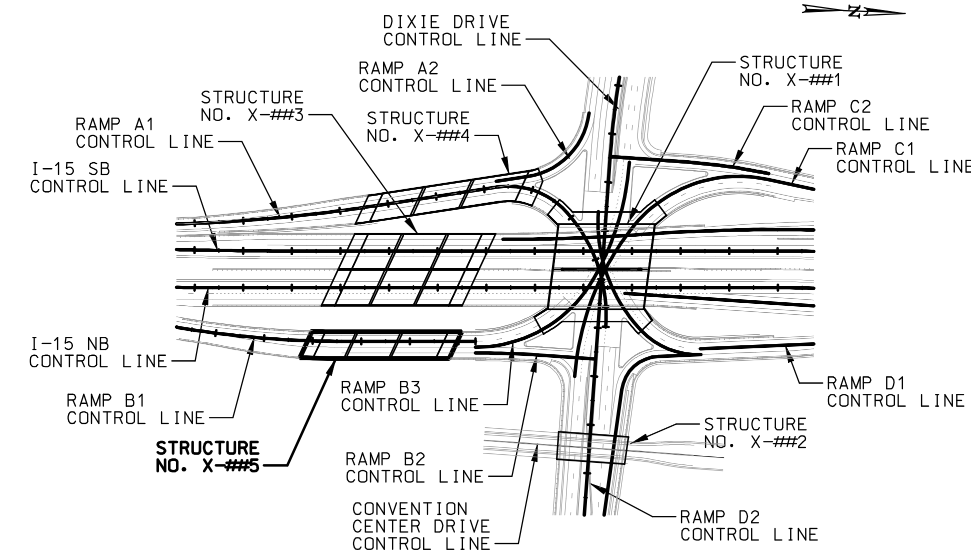
UTILITY INFORMATION NOT AVAILABLE



ELEVATION

NORMAL TO SANTA CLARA

*SLOPE IS PERPENDICULAR TO FRONT FACE OF ABUTMENT



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CAST-IN-PLACE CONCRETE:	f′c = 4,000 psi; fy (REINF.) = 60,000 psi; n = 8
PRESTRESSED CONCRETE:	f′c = 7,500 psi; f′ci = 6,500 psi; 0.6″ DIA. GRADE 270 LOW RELAXATION STRAND; fy (NONPRESTRESSED) = 60,000 psi; n = 6
STRUCTURAL STEEL:	fy = 36,000 psi (DRAIN GRATES)
WEARING SURFACE:	1/2″ CONCRETE; 35 psf (FUTURE)
DESIGN SPEED:	45 mph I-15 OFF RAMP
SEISMIC:	SEISMIC DESIGN PARAMETERS (2475 YR RETURN PERIOD, 3% PE IN 75 YRS) PGA = PEAK GROUND ACCELERATION = 0.22 g S1= MAX CONSIDERED EQ GROUND MOTION AT 0.2s = 0.52 g S = MAX CONSIDERED EQ GROUND MOTION AT 1.0s = 0.17 g SEISMIC PERFORMANCE LEVEL = LIFE SAFETY SITE CLASS D, SHL = IV, SDR = 4
TRAFFIC DATA:	2030 ADT = XX,XXX
PARAPET TEST LEVEL:	TL-4

QUANTITIES

ITEM	ESTIMATED	UNIT	AS CONST.

UTAH DEPARTMENT OF TRANSPORTATION
SALT LAKE CITY, UTAH
STRUCTURES DIVISION

DESIGN AFY 10/08 CHECK
DRAWN JMD 10/08 CHECK
QUANT. CHECK

APPROVAL RECOMM. DATE SENIOR DESIGN ENGR.
APPROVED FOR USE BY UDOT DATE UDOT BRIDGE ENGR.

REVISIONS
NO. DATE BY REMARKS

DIXIE DRIVE INTERCHANGE
I-15 OFF RAMP OVER SANTA CLARA RIVER - ALT. 1A
SITUATION & LAYOUT 1

PROJECT NUMBER S-I15-1(77)6

UTAH
COUNTY
X-##5
DRG. NO.

SHT. 1 OF 2

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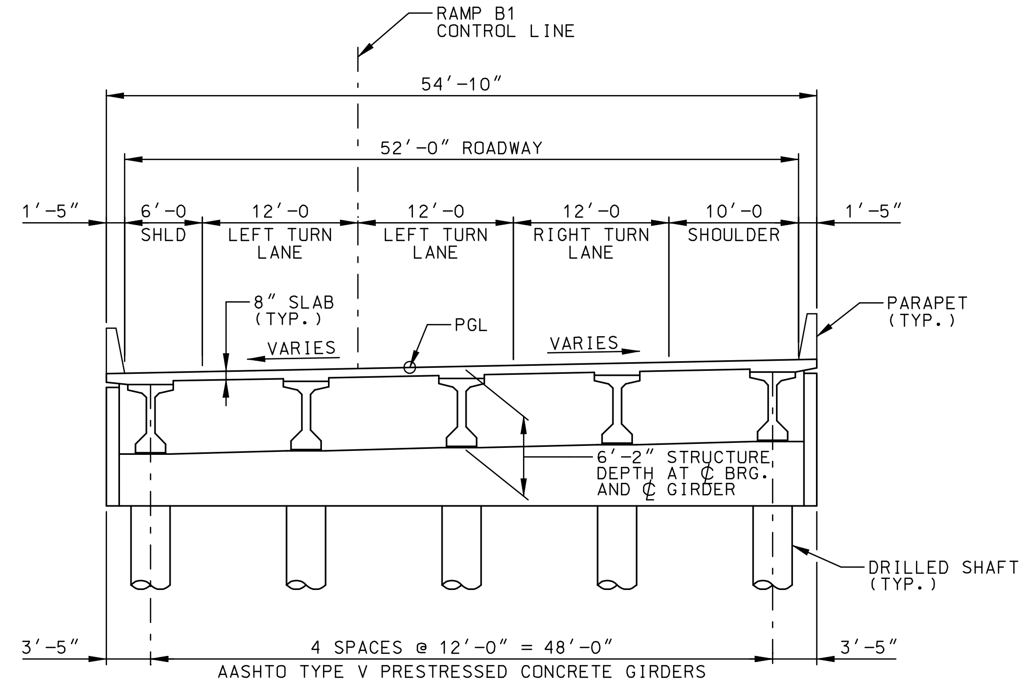
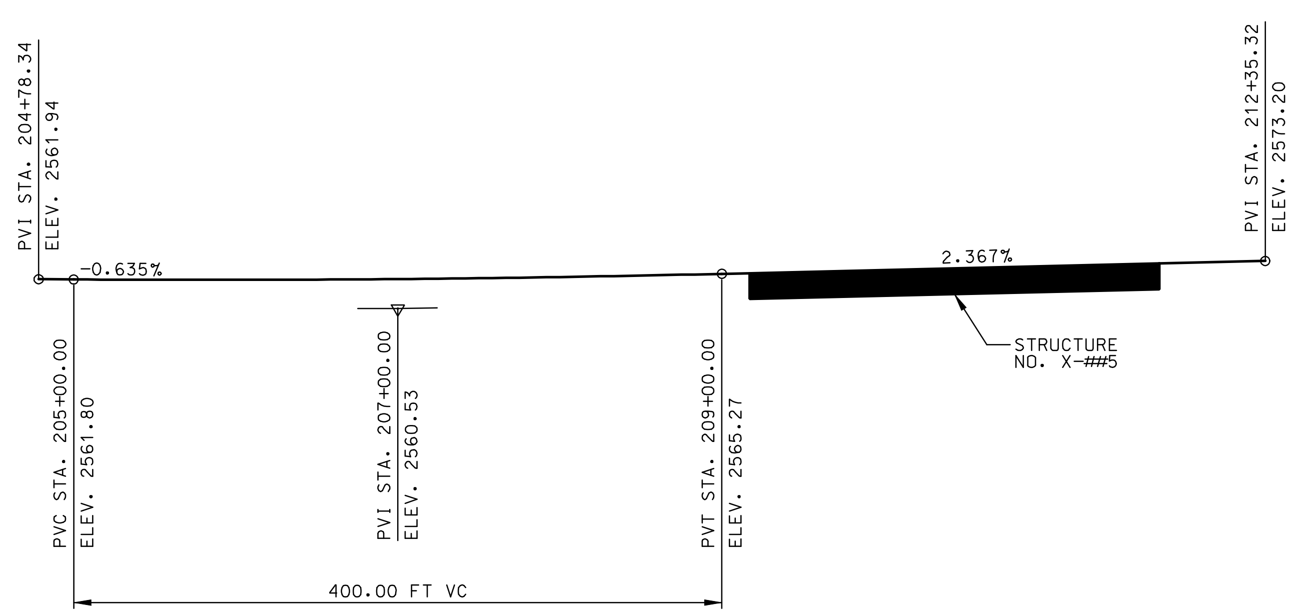


SECTION THRU STRUCTURE

(LOOKING AHEAD STATION)



RAMP B1 PROFILE

HYDRAULIC DATA

GENERAL INFORMATION:
DRAINAGE AREA = XXXX sq mi
FLOWLINE ELEVATION AT APPROACH SECTION = XXXX.XX ft
FLOWLINE ELEVATION AT BRIDGE SECTION = XXXX.XX ft

DESIGN INFORMATION (Q_D):
DESIGN FREQUENCY = 100 yr
DESIGN DISCHARGE = 13,000 ft^3/s
UNCONSTRICTED WSE AT APPROACH SECTION = 2549.33 ft
CONSTRICTED WSE AT APPROACH SECTION = 2548.33 ft
VELOCITY THROUGH BRIDGE SECTION = 9.0 ft/s

100-YEAR FLOOD EVENT (Q_{100}):
100-YEAR DISCHARGE = 13,000 ft^3/s
UNCONSTRICTED WSE AT APPROACH SECTION = 2549.33 ft
CONSTRICTED WSE AT APPROACH SECTION = 2548.33 ft
VELOCITY THROUGH BRIDGE SECTION = 9.0 ft/s
DEPTH OF CONTRACTION SCOUR = X.X ft
TOTAL SCOUR DEPTH AT LEFT ABUTMENT = XX.X ft
TOTAL SCOUR DEPTH AT RIGHT ABUTMENT = XX.X ft
TOTAL SCOUR DEPTH AT PIERS = XX.X ft

500-YEAR FLOOD EVENT (Q_{500}):
500-YEAR DISCHARGE = 24,000 ft^3/s
UNCONSTRICTED WSE AT APPROACH SECTION = 2553.56 ft
CONSTRICTED WSE AT APPROACH SECTION = 2551.16 ft
VELOCITY THROUGH BRIDGE SECTION = 12.5 ft/s
DEPTH OF CONTRACTION SCOUR = X.X ft
TOTAL SCOUR DEPTH AT LEFT ABUTMENT = XX.X ft
TOTAL SCOUR DEPTH AT RIGHT ABUTMENT = XX.X ft
TOTAL SCOUR DEPTH AT PIERS = XX.X ft

UTAH DEPARTMENT OF TRANSPORTATION
SALT LAKE CITY, UTAH
STRUCTURES DIVISION

DESIGN AFY 10/08 CHECK
DRAWN JMD 10/08 CHECK
QUANT. CHECK

APPROVAL RECOMM. DATE SENIOR DESIGN ENGR.
APPROVED FOR USE BY UDOT DATE UDOT BRIDGE ENGR.

NO. DATE BY REVISIONS REMARKS

DIXIE DRIVE INTERCHANGE
I-15 OFF RAMP OVER SANTA CLARA RIVER - ALT. 1A
SITUATION & LAYOUT 2

PROJECT NUMBER S-I15-1(77)6

UTAH
COUNTY
X-##5
DRG. NO.

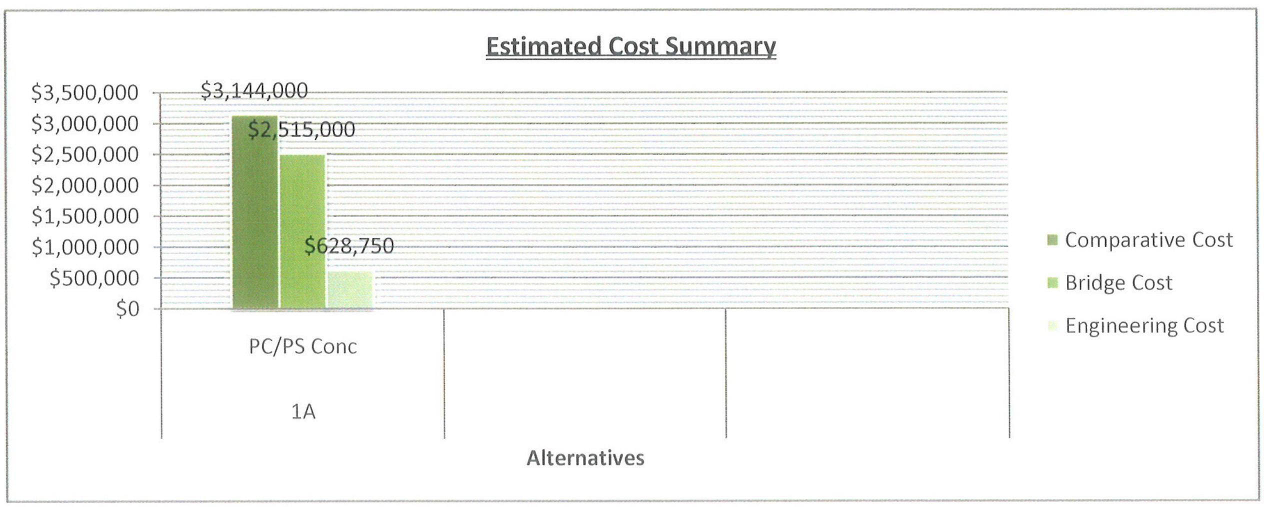
SHT. 2 OF 2

Preliminary Cost Estimate

Submitted By:	Mike Dobry, S.E.
Prepared By:	AJ Yates
Project Title:	Dixie Drive Interchange EA
Project Number:	S-I15-1(77)6
Structure:	I-15 On Ramp over The Santa Clara River
Alternatives:	1A - 3 Span Bridge PC/PS AASHTO Type V Concrete Girders
Contingency:	10%

Est. Cost Summary:

Alternative	1A
Structure Type	PC/PS Conc
Comparative Cost	$3,144,000
Bridge Cost	$2,515,000
Engineering Cost	$628,750
Cost per Deck Area	$159



HORROCKS
ENGINEERS
ONE WEST MAIN
P.O. BOX 377
AMERICAN FORK, UTAH 84003
(801) 763-5100

Project: Dixie Drive EA
Subject: I-15 On Ramp
Job No.:
Client:
By: AFY
Chk'd By:
Sheet:
Date: 10/08
Date:

Preliminary Cost Estimate cont.

Alternative: 1A - 3 Span Bridge PC/PS AASHTO Type V Concrete Girders

Deck Area: 15,840 ft^2

Cost Per ft^2 of Deck: $159

Item	Unit Cost	Unit	Quantity	Cost
Structural Concrete	$600	CY	1,265	$758,853
Reinforcing Steel - Coated	$2	LB	252,951	$430,017
Drilled Shafts (36" Diameter)	$400	FT	900	$360,000
Granular Backfill Borrow (Plan Quantity)	$60	CY	800	$48,000
Prestressed Concrete Members (x'-x" Type V)	$360	FT	1,425	$513,000
Structural Steel	$3	LB	1,092	$3,058
Expansion Joint	$250	FT	132	$32,947
Deck Sealer	$3	SY	1,760	$5,280
Electrical Work Birdge	$10,000	LUMP	1	$10,000
Bridge Aesthetics	$125,000	LUMP	1	$125,000

Total Estimated Bridge Cost: $2,286,155
10% Contingency: $228,615

Estimated Probable Bridge Construction Cost: $2,515,000
Estimated Design Engineering Cost: $251,500
Estimated Construction Engineering Cost: $377,250
Total Bridge Construction Cost: $3,143,750

Estimated Construction and Excavation Savings: $0
Comparative Cost: $3,144,000

HORROCKS ENGINEERS

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Project: Dixie Drive EA
Subject: I-15 Off Ramp
Job No.:

Client:
By: AFY
Chk'd By:

Sheet:
Date: 10/08
Date:

Preliminary Cost Estimate

Submitted By: Mike Dobry, S.E.
Prepared By: AJ Yates

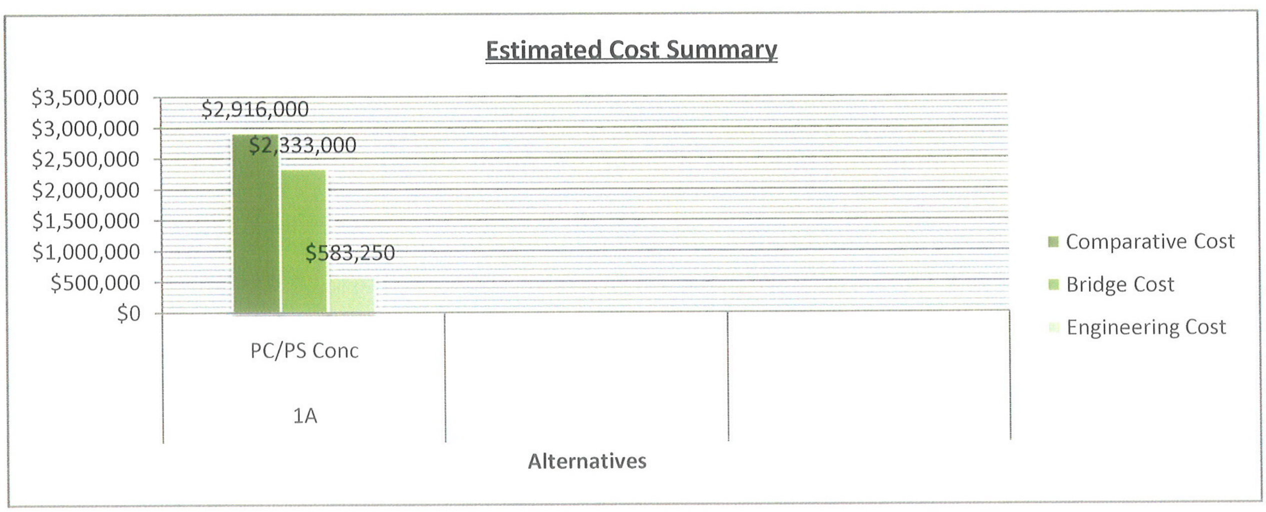
Project Title: Dixie Drive Interchange EA
Project Number: S-I15-1(77)6
Structure: I-15 Off Ramp over The Santa Clara River

Alternatives: 1A - 3 Span Bridge PC/PS AASHTO Type V Concrete Girders

Contingency: 10%

Est. Cost Summary:

Alternative	1A
Structure Type	PC/PS Conc
Comparative Cost	$2,916,000
Bridge Cost	$2,333,000
Engineering Cost	$583,250
Cost per Deck Area	$167



Preliminary Cost Estimate cont.

Alternative: 1A - 3 Span Bridge PC/PS AASHTO Type V Concrete Girders

Deck Area: 13,955 ft^2

Cost Per ft^2 of Deck: $167

Item	Unit Cost	Unit	Quantity	Cost
Structural Concrete	$600	CY	1,150	$690,239
Reinforcing Steel - Coated	$1.70	LB	230,080	$391,135
Drilled Shafts (36" Diameter)	$400	FT	900	$360,000
Granular Backfill Borrow (Plan Quantity)	$60	CY	800	$48,000
Prestressed Concrete Members (x'-x" Type V)	$360	FT	1,272	$458,098
Structural Steel	$2.80	LB	1,092	$3,058
Expansion Joint	$250	FT	121	$30,251
Deck Sealer	$3.00	SY	1,551	$4,652
Electrical Work Birdge	$10,000	LUMP	1	$10,000
Bridge Aesthetics	$125,000	LUMP	1	$125,000

Total Estimated Bridge Cost:	$2,120,433
10% Contingency:	$212,043
Estimated Probable Bridge Construction Cost:	$2,333,000
Estimated Design Engineering Cost:	$233,300
Estimated Construction Engineering Cost:	$349,950
Total Bridge Construction Cost:	$2,916,250
Estimated Construction and Excavation Savings:	$0
Comparative Cost:	$2,916,000

PROPOSED DESIGN PARAMETERS

SEISMIC STRATEGY

Seismic design and analysis will be performed in accordance with MCEER/ATC 49 Recommended LRFD guidelines for the seismic design of highway bridges and the UDOT Seismic Design Criteria. The earthquake resisting system will consist of the column hinging at the bents and passive pressure mobilized behind abutment backwalls if needed. The performance objective is Life Safety for all bridges. Simple span bridges will be designed and analyzed according to the simplified procedure of MCEER 4.1.

DESIGN CRITERIA

Specifications

- AASHTO *LRFD Bridge Design Specifications*, 4th Edition with 2008 Interim Revisions
- MCEER/ATC 49 *Recommended LRFD guidelines for the seismic design of highway bridges* and UDOT Guidelines
- UDOT Seismic Design Criteria

Loading

- Live Load: HL-93
- 2 UDOT standard parapets (570 plf each)
- 35 psf future wearing surface
- 8.0” deck is assumed for loading; 7.5” deck is assumed for structural resistance; 0.5” is considered wearing surface
- 3” haunch for concrete girders and 2” haunch for steel girders was assumed for dead load, but haunch area is not included in the section

Materials

• Cast-in-Place Concrete:	f'_c = 4,000 psi; f_y = 60,000 psi; n = 8
• Prestressed Concrete:	f'_c = 8,500 psi; f'_{ci} = 7,500 psi; n = 6
	f_y(prestressed) = 270,000 psi – 0.6” Low Relaxation Strand
	f_y(nonprestressed) = 60,000 psi
• Structure Steel:	f_y = 36,000 psi (Diaphragms and Grates)
	f_y = 50,000 psi (Girders)

Seismic Design

- Per MCEER/ATC 49 (2475 year return period. 3% PE in 75 years)
- PGA = Peak Ground Acceleration = 0.22g
- S_s = Max considered ground motion at 0.2s = 0.52g
- S_1 = Max considered ground motion at 1.0s = 0.17g

Girder Design

- Live load located in the maximum number of traffic lanes between parapet faces
- Continuous span modeling for steel girders
- Simple span modeling made continuous with live load for PC/PS concrete girders

Deck Design

- Empirical design (Article 9.7.2.5) used for main deck section. The thickness of deck was increased for large girder spacing.
- Equivalent strip method used for precast panels
- Concrete parapet designed to TL-4 railing test level (Article A13.2)
- Overhang designed for maximum moment in design cases
    - Transverse and longitudinal forces from railing impact
        - At inside face of parapet
        - At design section in overhang
    - Vertical loads from railing impact
    - Vertical static loads

COMPUTER SOFTWARE LIST

- BRASS-Girder (LRFD) version 2.0.1 – Design and rating steel girder-slab superstructures
- LEAP® Bridge version 8.0.2 including LEAP CONSPAN Rating and RC-PIER® – Design and rating of PC/PS concrete girder superstructures and concrete substructures
- SAP2000 version 12.0.0 – Finite element analysis for seismic modeling
- Microsoft® Excel 2007 – Various spreadsheets used in design and geometry calculations